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SYSTEM OF SURGERY

BY
J. CRUICKSHANK, ESQ.

OF THE
HOSPITAL FOR THE SICK AND WOUNDED

IN THE ARMY, AND
OF THE
HOSPITAL FOR THE SICK AND WOUNDED
IN THE NAVY.

IN TWO VOLUMES.

VOLUME II.

THE SIXTH EDITION.

REVISED AND CORRECTED.

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S Y S T E M
O F
S U R G E R Y:

BY

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ILLUSTRATED WITH COPPERPLATES.

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SYSTEM

SURGERY

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CHAPTER VI.

O F S U T U R E S.

SECTION I.

General Observations on Sutures.

AS futures are often necessary, not only in the treatment of wounds, but in almost every chirurgical operation, the subject obviously merits particular attention.

A variety of futures have been practised by surgeons, each of which has, from
Vol. III. B long

long experience, been applied to a particular purpose ; namely, The interrupted future ; the quilled future ; the glovers', and the twisted future. Many others are enumerated by authors ; but these four are the only futures at present in ordinary use ; and even of these, some might with propriety be laid aside.

The intention of every future, is to unite parts, which, either by accident or design, have been divided. Another mode of effecting this, is through the intervention of adhesive plasters : and this, by surgeons, has been termed the False or Dry Suture, in opposition to those that are performed by the needle, which are denominated the True or Bloody Suture.—But as the method of uniting divided parts, with the assistance of plasters, has already been noticed in Chapter II. when treating of wounds, it will not be necessary to enter upon the subject here.

SECTION II.

Of the Interrupted Suture.

IN deep wounds, when a re-union of the the divided parts is intended, we, for the most part, have recourse to the interrupted suture; but from what has already been fully explained, when treating of wounds, and from what will presently further appear, it does not seem to be so well adapted to this purpose as the twisted suture. When it is determined, however, to make trial of the interrupted suture, the following is the easiest mode of performing it.

In every wound where sutures are necessary, it has commonly been considered as good practice, to carry the needle and ligature to the bottom of the sore, so as to give as little room as possible for matter collecting underneath; and the usual method of effecting this, is by introducing the needle from without

B 2

inwards,

inwards, and again from the bottom of the wound to the same distance on the opposite side. But this future, it may be remarked, is much more neatly, and at the same time more easily performed, by passing both ends of the thread from within outwards; as may be readily done by using two needles upon each thread, instead of one. A needle being put upon each end of the same thread, and each needle being inserted at the bottom of the fore, and pushed outwardly, so as to pass out at a proper distance from the edge of the wound, the needles are then to be taken off, and the threads allowed to remain till all the ligatures are passed which the extent of the fore seems to require.

The number of ligatures necessary for any wound, must in a great measure depend upon the extent of the divided parts. By authors, in general, it has been laid down as an established rule, that one future is sufficient for every inch of wound. It will frequently, indeed, happen, that this number is sufficient; but in some instances,

stances, particularly where muscular parts are deeply cut transversely, and where consequently a great degree of retraction takes place, more stitches are necessary: Whenever a number of angles, too, occur in wounds, more ligatures are required than in straight wounds of the same extent; for, at every angle, however inconsiderable it may be, there ought to be a suture.

In passing the ligatures the skin should be pierced at a sufficient distance from the edge of the wound: for if they do not comprehend a thickness of parts, in some measure proportioned to the depth of the wound, and to the extent of retraction that may take place, they will be apt to cut through the parts entirely.—By some, we are desired to enter the ligatures, at a distance from the edges of the sore, nearly equal to the depth of the wound. This rule, however, will not always answer in practice. Thus, in very deep wounds, such, for instance, as are three inches or upwards in depth, there

can be no necessity for carrying the ligatures three inches from the edges of the fore; and again, in very superficial cuts, it sometimes happens that the ligatures ought to be passed out at a distance from the edges of the wound greater than its depth. It ought not, in almost any case, to be less than half an inch from the edge of the fore; and it will seldom happen, even in the largest wounds, that the distance of an inch is not found to be sufficient.

It will be readily understood, that the strength of the ligatures, and size of the needles, ought always to be proportioned to the depth of the fores and retraction of parts. The several sizes of needles represented in Plate III. are such as are found to answer best; and the ligatures to be used along with them ought to be such as nearly, though not entirely, fill the eyes of the needles. In order to make the ligatures pass with more ease, to render them more durable, and at the same time to make them more susceptible of a flattened

flattened form, which does not so readily cut through the contained parts as those that are round, they ought all to be well waxed.

As soon as the threads are all passed, the lips of the wound should be pressed together and supported by an assistant, till all the ligatures are firmly tied; beginning either in the middle of the wound, or at one end, as the operator may incline: In tying the knots, it is usual to pass the ends of the threads twice through the first noose; and when this is done, some have imagined that there is no necessity for more than one knot upon each ligature; but as two knots are easily made, and as every chance of their giving way is in this manner prevented, this precaution should not be omitted. It is a practice with some surgeons to insert a piece of lint between the first and second knots, or between the first knot and the skin below, in order to save the skin from the pressure of the knots; but no advantage of importance, is derived from it, while it

prevents the knots from being made with sufficient accuracy.

By some, we are desired not to bring the knots of the ligatures immediately upon the edges of the wound, but rather to carry them to one side upon the sound teguments: but whoever has tried both methods, will at once be sensible, that this is no improvement; for in no way can both sides of the fore be so equally supported, as when the knots are passed immediately above the lips of the divided parts.

SEC-

SECTION III.

Of the Quilled Suture.

AS the quilled future is still employed by some practitioners, I shall here mention the mode of performing it.

In deep wounds, attended with much retraction, it is always necessary to assist the operation of the ligatures, by means of bandages so applied as to afford as much support as possible to the divided parts: But, even with every assistance of this kind, it sometimes happens, that the divided parts cannot be kept together; retraction occurs to a greater or lesser degree, and the ligatures cut asunder the parts that they were at first made to surround.

With a view to prevent the teguments and other parts from receding, it was long ago proposed to add to the interrupted future what was supposed would afford an additional support; namely, quills, or pieces of plaster rolled up into the form of
of

of quills ; one of which being placed on each side of the wound, the doubling of the ligature is made to include the one, and the knot to press directly upon the other, instead of being made immediately on the edges of the sore, as was directed for the interrupted future.

It is at once evident, however, that the ligatures must here make the same degree of pressure on the parts through which they pass, as they do in the interrupted future ; and this being the case, it is equally obvious, that the interposition of these substances cannot be of any use. This future is accordingly now very rarely practised, and it is probable that it will be soon laid entirely aside.

SEC-

SECTION IV.

Of the Glovers' Suture.

THIS suture receives its name from being that which glovers commonly use. As it is exceedingly simple, and very universally known, it does not here require a particular description: I shall therefore just shortly observe, that it consists in a series of stitches all connected with each other, and continued in an oblique spiral direction along the course of the divided parts intended to be kept together.

This suture has hitherto been universally employed for reuniting such parts of the intestines as have been divided by wounds: but, in treating of injuries of the intestines, I shall endeavour to show, that the same end may be more perfectly attained, and probably with less danger,
by

by means of the interrupted future ; so that as this future has almost never been applied to any other purpose, it will likewise in all probability soon fall into disuse.

S E C-

SECTION V.

Of the Twisted Suture.

BY the term Twisted Suture is meant that kind of ligature, by which parts, either naturally or artificially separated, are united together, by means of strong threads properly twisted round pins or needles pushed through the edges of the divided parts.

This suture is commonly employed for uniting the parts in the operation for the hare-lip; and this indeed is almost the only use to which it has been hitherto applied: But I may here remark, that it may with much advantage be put in practice in other cases, particularly in all artificial or accidental divisions of the lips or cheeks: And, in every wound in other parts that does not run deep and in which sutures are necessary, this suture is preferable to the interrupted or any other.

In

In very deep wounds, for instance in all that extend to a greater depth than an inch, the interrupted future is the only one that is admissible; for, in all deep cuts, the pins necessary in the twisted future cannot with propriety be employed, as they cannot be introduced to such a depth, and afterwards so twisted with ligatures as to reunite the divided parts, without exciting severe pain. In such wounds, therefore, we must of necessity employ the interrupted future. But it may here be remarked, that wounds of this depth requiring the aid of futures, are seldom met with: so that, in by much the greatest proportion of wounds requiring futures, the twisted future may be in our power; and whenever it is so, it ought certainly to be preferred, as being obviously better calculated, even than the interrupted future, for the retention of divided parts. The pins made use of for twisting the threads upon, should be of a flat form, so as not to cut the parts through which they pass so readily as the ligatures

tures employed in the interrupted suture ; and thus we obviate one great objection to the latter ; for, every practitioner must be sensible of this being the chief inconvenience of the interrupted suture, that when muscular parts are divided, so as to produce much retraction, the ligatures employed for retaining them, almost constantly cut them through before they unite ; an occurrence which the flatness of the pins that we employ for the twisted suture, is particularly well calculated to prevent.

The pins used in this operation have commonly been made of silver ; and, in order to make them pass with more ease, they are made with steel points. As gold pins, however, are capable of receiving a sufficient degree of sharpness, which renders steel points unnecessary ; and as gold is more cleanly than silver, from its not acquiring so readily that kind of crust which immersion in fluids is apt to produce upon the other ; pins of this metal are therefore better.

The

The form and size of pins represented in Plate IV. are by experience found to be the best for every ordinary purpose ; but for particular cases, the size must no doubt be subject to some variety.

The manner of performing this operation is as follows : The divided parts must by the hands of an assistant be brought nearly into contact ; leaving just as much space between the edges of the wound, as to allow the surgeon to see that the pins are carried to a proper depth. This being done, one of the pins must be introduced through both sides of the wound, by entering it on one side externally, pushing it forwards and inwards to within a little of the bottom of the wound, and afterwards carrying it outwards through the opposite side, to the same distance from the edge of the fore that it was made to enter at on the other.

The distance at which the needle ought to enter from the edge of the fore, must depend on the depth of the wound, and degree of retraction that takes place ; but
whatever

whatever the deepness of the wound may be, the pins should pass within a very little of its bottom; otherwise the parts which lie deep will run a risk of not being united, which will be very apt to give rise to fores or collections of matter.

In passing the pins through the sides of the wound, if the skin and other teguments are not more firm than ordinary, it may commonly be done with the fingers alone, especially if the pins are made with small heads or knobs for the fingers to press upon; but when firmness of parts and other circumstances render the entrance of the pins difficult, the instrument termed by the French *Porte-aiguille*, very effectually removes this inconvenience.—In Plate IV. fig. 1. is represented the best form of this instrument that has yet been invented.

The first pin being passed in this manner near to one end of the sore, and the parts being still supported by an assistant, the surgeon, by means of a firm waxed ligature, passed three or four times round

and across the pin, so as nearly to form the figure of 8, is to draw the parts through which it has passed into close contact; and the thread being now secured with a loose knot, another pin must be introduced in the same manner at a proper distance from the first; and the thread with which the other was fixed, being loosened, and in the same manner carried round this pin, others must be introduced at proper distances along the whole course of the wound, and the same ligature should be of a sufficient length for securing the whole.

The number of pins to be used, must depend upon the extent of the wound. But whether the wound is large or of small extent, a pin should be inserted near to each end of it, otherwise the extremities of the cut are apt to separate, so as not to be afterwards easily reunited. In large wounds, the pins being introduced at the distance of three quarters of an inch from each other, will in general answer; but, in wounds of smaller extent,

a greater number of pins are necessary in proportion to their dimensions.

Thus, in a wound of an inch and half in length, three pins are requisite; one near to each end, and another in the middle: Whereas, five pins are sufficient for a wound of three inches and a half long, allowing one to be within a quarter of an inch of each end of the wound, and the others along the course of it, at the distance of three quarters of an inch from each other.

The pins being all introduced and secured in the manner I have mentioned, nothing remains to be done, but to apply a piece of lint, wet with mucilage, or spread with any emollient ointment, along the whole course of the wound, in order to exclude the external air as much as possible.

With the view of preventing the ends of the pins from hurting the skin below, it is usual to apply a small bolster of lint under each of them; but as this always does harm, by tending to press the pins

against the parts through which they have passed, it ought certainly to be omitted. When, however, the patient complains of being hurt by the ends of the pins, this may be easily prevented by introducing between them and the skin beneath pieces of thin linen, spread with adhesive plaster.

In order to give as much chance as possible to this operation, it has commonly been advised, immediately after the pins are secured, to apply the uniting bandage over the whole, with the view of supporting the contiguous parts. The least reflection, however, renders it evident, that every degree of pressure made in this manner must do harm; for, the bandage being made to rest immediately upon the pins, a considerable degree of pain must of course ensue from it; which happens indeed in such a degree, that, in every instance in which I have known it employed, it either did harm, by pressing upon the pins; or, if this did not happen, no advantage was derived from it, from its
not

not being applied with such tightness as to afford any support to the parts below. In some instances, indeed, I have employed adhesive plasters with obvious benefit, along with the twisted suture: By applying a portion of plaster, spread upon leather, between every two of the pins, we are enabled to draw the parts very forcibly together with pieces of thread or small tape previously attached to each portion of the leather, and where the retraction of the divided muscles is more than usual, this precaution should never be omitted: I have had recourse to it with much advantage in the operation for the hare-lip.

We have next to consider the length of time which the pins should be allowed to remain. When they remain long, they generally do harm, by the irritation and consequent retraction of parts, which they are apt to produce; and again, if not long enough continued, that degree of adhesion is not formed between the divided parts that is necessary for their retention, so that

the effect of the operation is in a great measure, if not entirely, lost.

In wounds of no great depth, I have, by experience, found, that firm adhesion takes place in the space of five days ; and that six, or at most seven days, are sufficient for wounds of the greatest depth.

But, in speaking of this, it must always be understood, that the patient's state of health will have much influence on the length of time that may be necessary. In specifying the time required for this purpose, the operation is supposed to be done in a healthy state of body. When the patient labours under disease it is impossible to ascertain this circumstance with precision: In such cases we must be determined by the age of the patient and state of his constitution at the time.

As soon as the pins are withdrawn, the uniting bandage may be applied with much advantage as a support to the parts newly united ; but, as slips of adhesive plaster, when applied, as I have advised above, to each side of the cicatrix, may be made to
answer

answer the purpose in a more exact manner, this mode of supporting the parts will in general be preferred.

As the twisted suture, when properly performed, is a very neat operation; as its consequences are in general of importance; and as it may, with much advantage, be made to supersede the use of almost every other suture, a few instances only excepted, I have here judged it proper to consider it with more attention than has hitherto been commonly bestowed on it.

CHAPTER VII.

Of the LIGATURE of ARTERIES, and other Means employed by Art for putting a stop to HEMORRHAGIES.

IN every wound, whether produced by accident, or by surgeons in performing operations, the first circumstance requiring attention, is the hemorrhagy; which may proceed either from one or more large arteries, or it may be produced by a general oozing from the smaller vessels over the surface of the sore.

A surgeon being called to a person losing much blood from a large artery, the first step to be taken, is, to put a temporary stop to the discharge, by means of pressure, till
by

by the application of ligatures a more effectual remedy is obtained. In the head, as well as in the trunk of the body, the easiest way of effecting this is to press doses of soft lint or dry sponge upon the mouths of the divided arteries, either by the hands of an assistant, or by the proper application of a bandage: Or, when pressure can be effectually applied to the superior part of the artery, it ought to be preferred; as it not only secures the vessel equally well, but more readily admits of a ligature being afterwards applied to the divided part of it.

When, again, hemorrhagies take place in any of the extremities, and where pressure can be made with ease on the superior parts of arteries, for such cases we are in possession of a remedy, which, when skilfully applied, never fails to put an immediate stop to all further loss of blood: I mean the Tourniquet.

Till the invention of this instrument, and it was not known till the last century, Surgery remained extremely defective

tive indeed. No operation of importance could be performed on any of the extremities, but with much hazard; so that large wounds frequently proved fatal from the want of it, which otherwise would have been attended with no danger.

As the invention of the Tourniquet is claimed by different persons, and even by different nations, I shall not here pretend to say from whence it originally came: but whoever was the inventor, the first with which the world was made acquainted, was exceedingly simple; inasmuch, that we are now apt to be surpris'd at the discovery having been left to such a late period. A small cushion being placed upon the course of the principal artery of a limb, a circular rope or bandage was made to pass twice round it; and a small wooden handle being then introduced into one of the folds of the rope, for the purpose of twisting it, the cushion by these means was press'd with so much force upon the artery, as to put an effectual stop to the circulation

circulation in all the under part of the limb.

Mr Petit, an eminent surgeon of Paris, was the first who improved this instrument : He connected the circular bandage with a screw, which was so contrived as to produce the pressure chiefly on the principal arteries, without materially affecting the rest of the limb. It had also this advantage over the other instrument, that the operator himself could manage it, without employing an assistant ; but it was liable to one great inconvenience from the very circumstance which, by the inventor, was considered as an improvement. This instrument of Mr Petit being made to act upon the principal arteries only, the smaller vessels communicating with these, not being properly compressed, discharge blood freely from the instant they are cut ; and as this proves always troublesome in the course of operations, different improvements have of late been made on it. Fig. 1. Plate V. represents the best that has yet been invented.

By

By means of this instrument in its now improved state, the blood is very easily and effectually stopped; and as it grasps the whole member equally, all the collateral branches, as well as the principal arteries, are equally compressed by it. It has also this material advantage over every other instrument of this kind, that, when properly applied, a single turn, or even half a turn of the screw, is sufficient either for allowing a flow of blood, or for putting a total stop to it.—The manner of using it, is this.

Let a cushion, three inches in length, by one inch and half in diameter, be formed of a linen roller, tolerably firm, but yet not so hard as to render the pressure produced by it painful: This being placed upon the course of the principal artery of the limb, let it be firmly secured by one or two turns of a circular roller of the same breadth with the cushion itself.

The instrument A, with the strap connected with it, being now placed upon the limb, with the handle of the screw B
on

on the side of the member opposite to the cushion upon the artery, the strap C is to be carried round the limb directly over the cushion, and to be firmly connected on the other side to the buckle D. In thus connecting the strap and buckle together, it ought to be done with much firmness, so that the screw may afterwards operate with as much advantage as possible, in producing a sufficient degree of pressure. When proper attention is given to this, a single turn of the screw proves sufficient, as I have observed above, for putting a stop to the circulation of blood in the limb; but when the strap has not been made tight at first, several turns of the screw become necessary; which never fails to prove troublesome in the course of an operation, and which ought therefore to be guarded against.

When it is therefore determined, that any further loss of blood from a divided artery is to be prevented, pressure on the superior part of the vessel should be immediately applied, by the hands of an assistant,

sistant, or by a proper bandage, when the cut is on the head or trunk of the body ; and by the tourniquet in any of the extremities.

The patient being in this manner secured from immediate danger, the practitioner must endeavour to prevent a return of the hemorrhagy on the tourniquet being removed.

The ancients, as I have observed above, were ignorant of the use and application of the tourniquet, and they were equally deficient in the employment of means for giving a permanent security against the flow of blood from divided vessels. It will therefore readily occur to practitioners of the present day, that in this imperfect state of chirurgical knowledge, they must in all important operations have incurred much risk of doing harm : To the smaller vessels they applied dossils of linen covered with astringent powders or tinctures ; and for divisions of the larger arteries, searing with hot irons was their only resource.

On

On this last remedy, however, although it commands a temporary stoppage of the blood in every case of hemorrhagy, we ought not to place much dependence ; for, if not carried to a greater depth than in general is consistent with safety, the pulsation of the larger arteries very soon overcomes all the resistance produced by the eschar obtained from the cautery.

In ancient times, however, when this was the most effectual remedy with which the world was acquainted, practitioners were under the necessity of employing it ; and, at that period, it is not surprising to find them exercising their genius in inventing a variety of styptic applications : But since surgery became enriched with that material improvement of securing the larger arteries with ligatures, a practice easily effected, and with very little pain to the patient, we are rather surprised to find that remedies of this class are still searched after. If the use of ligatures were in itself attended with difficulty ; if, by experience, it had been found to produce

duce any dangerous consequences ; or, if it had been frequently known to fail in answering as a full security against the hemorrhagies of the largest arteries ; in any of these events, it ought to be the business of practitioners to endeavour to procure a more effectual remedy. But, as the ligature of arteries is very simple in its nature ; as the pain arising from it is trifling ; as few instances occur of any thing bad being produced by it ; and especially as, when properly performed, it never fails to prove a sure preventative against all loss of blood from the larger arteries ; there can be no good reason for anxiously seeking after other remedies.

Agaric, common sponge, and other fungous substances have been much extolled for their styptic powers ; and chalybeate and vitriolic solutions, as well as all the variety of mineral acids, have in different forms been held forth to the public as effectual remedies of this nature ; not only as nostrums, by those of less liberal principles,

principles, but, what is more surprising, in some instances by practitioners of character.

With the former class of men, this happens as a common occurrence in the course of their profession, and is therefore to be expected; but a perseverance in quest of new styptics on the part of Surgeons of reputation, who are well acquainted with the beneficial effects of ligatures, must proceed from a degree of nicety and refinement, which may create much trouble to themselves, and which in all probability can never be productive of any advantage to their patients.

I may therefore venture to say, that it should be considered as an established maxim in surgery, That in hemorrhagies from the larger arteries, no styptic whatever ought to be trusted, and that we should place dependence only on the use of ligatures: I shall now therefore proceed to consider the easiest and most effectual method of putting this remedy in practice.

Various methods have been proposed for securing arteries with ligatures. The practice now in common use, is, by means of a curved needle, to pass a ligature of sufficient strength round the mouth of the bleeding vessel, including a quarter of an inch all round of the contiguous parts *, and afterwards to form a knot upon the vessel and other parts comprehended in the noose.

One important objection, however, to this practice, is, that the nerves accompanying the bloodvessels, together with a considerable portion of the muscular substance through which they pass, must always be tied with ligatures formed in this manner. From this circumstance, much unnecessary pain is produced, by the nerves and contiguous parts being compressed along with the arteries; and, in some instances, severe convulsions have arisen from this, not only of the part chiefly affected, but of the whole system.

Spasmodic

* Sharp's Surgery,—on Amputation.

Spasmodic twitches frequently take place after the amputation of limbs, and are often the source of much distress. In some instances, this symptom is no doubt the effect of other causes; but in various cases it has happened, that the clearest proof has been obtained of its arising from the ligatures of arteries applied in an improper manner. When convulsions occur after amputations, and the usual means of preventing them are found to fail, effectual relief may be frequently obtained by undoing the ligatures, so as to remove the compression upon the nerves; care being taken at the same time to renew the ligatures upon the arteries alone, without comprehending any of the contiguous parts.

Thus, it is not from the mere application of ligatures to bloodvessels, but from the improper manner in which the operation is performed, namely, the including nerves and other parts, instead of tying the arteries alone, that the bad symptoms in such cases proceed.

Practitioners have commonly been afraid of tying arteries by themselves, without the intervention of some of the surrounding parts: This has happened from an idea that has prevailed of the coats of bloodvessels not being sufficiently firm to bear a degree of compression necessary for the prevention of hemorrhagy.

This, however, proceeds upon the supposition, of the coats of arteries not being so strong as they really are; and that a great degree of force is necessary for retaining their sides in contact.

But it is now well known, that even very small arteries are possessed of much firmness; and it is also known, that even in the largest arteries of the arm and thigh, a very slight degree of compression is sufficient, not only for restraining hemorrhagy, but for securing the ligature on the very spot to which it is first applied: In small vessels, the force necessary for this purpose is trifling indeed; being much less than is commonly employed.

It

It has also been objected to this mode of securing bloodvessels by themselves, that the ligatures are more apt to slip than when some of the surrounding parts are tied along with them; and, in some instances, it is said that arteries retract so far, that they cannot in any other way be laid hold of, than with the crooked needle in the ordinary method.

Long and repeated experience, however, of a few individuals, in regard to this mode of taking up arteries by themselves, has put the fact beyond a doubt, that it is as secure as any other yet invented. Fatal hemorrhagies, after capital operations, either from inattention, or some other cause, sometimes indeed happen in the hands of the most expert surgeons, but they occur more frequently when the curved needle has been employed, than when the bloodvessels are secured by themselves, without any of the contiguous parts being included.

From the result of my own experience, indeed, I should be induced, even in this

point of view, to draw a conclusion in favour of the practice I recommend. For both among hospital patients, and in private, I have known different deaths occur from the bleeding of stumps after the amputation of limbs: and whether this proceeded from the ligatures having slipped from the arteries; or, that some of the vessels which did not appear during the operation, had been of course passed over, and had afterwards burst out; I shall not pretend to determine: but in all of these, *the crooked needle only* had been used during the operation; and it has so happened, that I never met with a single instance of a similar occurrence where the arteries were secured by themselves with the tenaculum; an instrument to be hereafter mentioned.

In a few instances it may happen, that a bleeding vessel, by lying at the bottom of a deep wound, cannot be laid hold of in any other manner than by passing a curved needle and ligature round it. Such occurrences, however, are so rare, that I have met with few instances in which hemorrhagy

morrhagy could not be as easily restrained with the tenaculum, as with the crooked needle.

In all operations whatever, to save unnecessary pain, is a very important point. The object in view ought no doubt to be attained in the most complete manner; but that mode of operating, which is equally effectual with any other, at the same time that it is the least painful to the patient, ought in every instance to be preferred. Now, with respect to the point in question, as I have already made it appear that arteries may be tied with as much safety by themselves as when connected with any of the neighbouring parts, the difference of pain arising from the two modes of operating, ought at once to give the preference to that which is productive of the least degree of it.

When any of the contiguous parts, particularly when the nerves, which generally accompany bloodvessels, are included in the same ligature with an artery, a circumstance scarcely to be avoided when

the curved needle is employed, a very severe degree of pain is often excited by tying the knot. I have known various instances of patients, bearing the amputation of limbs, and of cancerous breasts, without shrinking, but who complained severely of the pain excited by tying the arteries with the crooked needle: While, on the contrary, the pain arising from the use of the tenaculum, is so trifling, that, when properly done, even the most timid patients seldom complain of it.

For some time after I first made use of the tenaculum, curiosity induced me, in different instances, to put the point in question to the test of experiment: And to render the trial fair and decisive, it was always made upon the same subject, under the same operation. Different vessels were secured in the ordinary manner with the crooked needle; whilst others were laid hold of with the tenaculum: But so great was the difference, that the one seldom gave much uneasiness; while the patient commonly

commonly complained of the other as the most painful part of the whole operation.

Among other advantages attending the tying of arteries with the tenaculum, there is one which I have not mentioned: It often happens after the amputation of limbs, as well as in other operations, that the ligatures do not come easily away, from their being made to run so deep as with the curved needle is commonly necessary. In some instances, much pain and trouble has occurred from this, the ligature remaining immoveable for a great many weeks: And after all, I have known it necessary to cut it out with a scalpel. But when the tenaculum is used, every risk of this is avoided, as the ligatures generally drop of their own accord, in the course of the third or fourth dressing of the sore.

I shall, therefore, consider it as a practice that should be established, that in forming the ligature of arteries, the nerves and other contiguous parts ought to be avoided.

For

For the purpose of performing this with ease and safety, various kinds of forceps have been invented, with which the divided arteries are laid hold of and pulled out, so as to admit of the ligatures being applied.

For the larger bloodvessels, forceps have been found to answer; but for smaller arteries, they are not so useful as the tenaculum, represented in Plate III. fig. 1. and 8. And as a hook of this form answers equally well in the larger arteries also, the use of forceps may therefore be laid aside. The manner of using the tenaculum is this.

In order to discover the arteries to be tied, the tourniquet with which they are secured must be slackened by a turn or two of the screw; and the moment the largest artery of the fore is discovered, the surgeon should fix his eye upon it, and immediately restrain the blood with the tourniquet again. A noose having been previously formed on the ligature, and passed upon the tenaculum, the operator should

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now push the point of the instrument through the artery ; and at the same time should pull it out to the extent of an eighth part of an inch or thereby : The noose should now be pulled over the point of the tenaculum by an assistant ; and being pressed sufficiently upon the artery, a knot should be formed with it of such tightness as may be necessary : In forming this ligature, the Surgeon's Knot, as it is termed, should be preferred : It is done by passing the thread twice through the first noose, and as some additional security is obtained by forming a second knot above the first, it should never be omitted. It is easily done ; and on security in this point, the patient's life may in a great measure depend.

The strength of the ligature should always be proportioned to the size of the artery ; but this is a circumstance to be at all times determined by the judgment of the practitioner, as must also the force to be employed in forming the knots. To what was already said upon this point, I shall

shall here add, that a very trifling force is sufficient for securing even the largest arteries : and that, after such a force has been applied, as evidently restrains the flow of blood, no further compression should be made.

The principal artery being in this manner secured, all the arteries which have been cut must be taken up in a similar manner, by first loosening the tourniquet in order to discover them, and afterwards applying a ligature upon each.

It often happens, however, that the loss of blood, in the course of an operation ; a tendency to deliquium which may continue for some time ; the fear which the patient labours under ; and the degree of cold to which the fore is exposed ; have altogether such an effect upon the smaller arteries, as to prevent them for the time from discharging their contents : and as arteries left in this state, without being secured, generally burst out afterwards, a circumstance which always occasions much trouble to the practitioner, as well as pain
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and risk to the patient, nothing should be omitted that can in any manner of way tend to prevent it.

With this view, the tourniquet should be made perfectly loose ; any coagulated blood on the surface of the fore should be carefully washed off with a sponge and warm water ; and the patient, if likely to faint, should take a glass of wine, or some other cordial : and after all, the surgeon ought to examine, with the most minute attention, the course which the vessels of the part usually take.

This being done, every artery that can be distinguished, should be secured with a ligature ; for such as may seem to be very small, while the part is yet exposed to the air, may discharge large quantities of blood after the patient becomes warm in bed ; when the solids are thereby relaxed, and the fluids expanded : and, as no harm can arise from ligatures being applied to every artery that is cut, it ought in every instance to be done.

When

When the principal arteries of a stump have been taken up, and blood still continues to be discharged, but which appears to come from a few small vessels only, the surgeon, unless he is much accustomed to this kind of business, is apt to think, from their trifling appearance, that he need not be at the trouble of tying them, and that the pressure of the necessary bandages will prove sufficient : Where the discharge proceeds from the whole surface of a wound, and when no particular vessel can be distinguished, we must of necessity trust to this remedy ; but, whenever an artery can be discovered, of whatever size it may be, it ought unquestionably to be secured with a ligature. I have insisted the more upon this, from having often observed both distress and danger induced, by want of attention to this part of an operation, and from some late publications having very improperly endeavoured to shew, that there is no risk in leaving all the small arteries untied that are cut in operations ; a practice fraught with much perplexity to practitioners,

practitioners, and with the utmost hazard to patients.

When, from the deepness of a wound, or from any other cause, some particular artery cannot be properly secured with the tenaculum ; we are under the necessity, as I have already observed, of trusting to the crooked needle, and the following is the mode of using it.

The operator should be provided with needles of various sizes, and of different forms. The needles in ordinary use, are for many purposes too much crooked ; for, in general, they are more easily managed when their curvatures are less.

The needles that I have mentioned for the interrupted suture, represented in Plate III., answer equally well for the ligature of arteries.

Those in common use are made with three edges, one on each side, and a third on the concave part of the needle. There is no necessity, however, for more than two. Needles enter, indeed, more easily with two than with three edges ; and as the
third

third edge on the concave side, renders them liable to injure arteries and other parts in the course of their introduction, it ought to be omitted.

A needle of this shape, armed with a ligature of a size proportioned to itself, and to the vessel to be taken up, is to be introduced at the distance of a sixth or eighth part of an inch from the artery ; and being carried at least one-half round the artery, at a depth sufficient for retaining it, it must now be drawn out ; and being again pushed forward, till it has completely encircled the artery, it is again to be pulled out, and a knot tied in the manner that I have advised in using the tenaculum.

In this manner, either by the use of the crooked needle, or the tenaculum, every hemorrhagy arising from the division of one or more arteries, may in general be restrained ; but it frequently happens, that considerable quantities of blood are discharged, not from any particular vessel, but from all the small arteries over the surface

face of a wound : In wounds of great extent, particularly after the extirpation of cancerous breasts, and in other operations where extensive sores are left, this kind of hemorrhagy often proves troublesome, from being very difficult to suppress.

Hemorrhagies of this kind seem evidently to proceed from two very different and opposite causes ; which, in the method of cure, require particular attention.

FIRST, They sometimes take place in very robust constitutions, and proceed either from too great a quantity of blood in the arteries and veins, or from an excess of tone in the vessels themselves ; or, perhaps, from both of these causes being combined. But, SECONDLY, They appear to happen most frequently in constitutions quite the reverse of this, namely, in such as are weak and relaxed, either from a putrid dissolved state of the blood, from want of tone in the vessels, or in some instances from a concurrence of both.

In healthy patients, when the fluids are not tainted with putrescency, and the solids are possessed of their natural tone, as soon as the large arteries of a wound are secured, the smaller vessels for the most part recede within the surface of the surrounding parts: This they do in consequence of that contractile power with which, in a state of health, they are endowed, and from the stimulus of the external air to which they are now exposed. This of itself would often prove sufficient for restraining hemorrhagies from small arteries; but in the sound state of constitution to which I allude, another powerful agent is provided for producing the same effect. From the extremities of the divided vessels which at first discharged red blood, there now, in their contracted state, oozes out a viscid fluid, containing a certain proportion of the coagulable part of the blood; and this on spreading over the surface of wounds, has, by its balsamic agglutinating powers, a very considerable effect in restraining the hemorrhagy.

Where

Where the constitution is sound, and where neither of these states of disease preponderates over the other, it is observed, as soon as the larger arteries of wounds are secured, that nature, in the manner I have described, generally puts a stop to all further discharge. So that when this does not happen, and when a tedious oozing continues from the surface of a sore, we ought to pay particular attention to the habit of body with which it is combined.

In young vigorous patients, where the tone of the muscular fibres is considerable, the most effectual means of putting a stop to this variety of hemorrhagy, is to relax the vascular system, either by opening a vein in some other part, or by undoing the ligature on one of the principal arteries that have been tied, so as to allow it to bleed freely: Those violent spasmodic twitchings, too, so frequent after the amputation of limbs, when they do not depend on a nerve being tied in the ligature with the artery, are in this manner more

effectually relieved than by any other means.

By the same means, the patient from being in a febrile heat and much confused, soon becomes tranquil: The violent pulsation of the heart and larger arteries abates, and the blood not being propelled with such impetuosity, the smaller vessels of the part are thereby left at more liberty to retract; and as in this state they do not pour forth red blood so freely, they are the more readily covered with that viscid glutinous fluid which I have already shewn to be one of the most important means provided by nature for the cure of hemorrhagies.

At the same time that we thus endeavour to allay the commotion produced in the system, the patient should be kept exceedingly cool; wine and other cordials should be avoided; cold water, acidulated either with the mineral or vegetable acids, should be his only drink; motion of every kind should be guarded against; and the wound being covered with soft lint, moderate

derate preffure fhould be applied over the whole furface of the fore with a proper bandage.

In every extenfive wound, attended with this kind of hemorrhagy, and particularly when violent fpafmodic affections of the mufcles fupervene, together with the means that I have mentioned, large dofes of opiates often prove ufeful : by allaying irritation and pain, they often prove more beneficial than any other remedy.

As foon, therefore, as a fufficient quantity of blood has been difcharged, and the wound is drefled, and the patient laid to reft, a dofe of opium, proportioned to the violence of the fymptoms, fhould be given. It muft, however, be remarked, that in all fuch circumftances, opiates fhould be given in large dofes, otherwife, inftead of anfwering any good purpofe, they feem frequently rather to do harm ; fo that, whenever opium is employed, it ought to be in fuch quantities as may be fufficient for the intended effect.

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Although

Although this kind of hemorrhagy sometimes occurs in firm constitutions, yet it is certainly more frequent in relaxed enfeebled habits, where the solids have lost part of their natural strength, and the fluids have acquired some degree of putrescency. As the vessels in this situation are supposed to be deprived of that degree of tone of which we wish them to be possessed, instead of restraining the patient from cordials, as is usually done in cases of hemorrhagy, a moderate use of wine should be prescribed; for nothing tends so much in such circumstances to restrain hemorrhagies, as a well-directed use of cordials. By tending to invigorate and brace the solids, they enable the arterial system to give a due resistance to the contained fluids, while the same cause has no inconsiderable effect in restoring to the fluids that visciditity of which in all such instances we suppose them to be deprived.

When, therefore, tedious hemorrhagies occur in relaxed debilitated habits, a free
use

use of Port, Madeira, or any other wine equally good, should be allowed; a nourishing diet also becomes proper; the patient should be kept cool: and the mineral acids, from their known utility in every kind of hemorrhagy, ought also to be prescribed. Rest of body is likewise proper; and opiates, when indicated either by pain or spasmodic affections of the muscles, ought never to be omitted.

Together with remedies of this kind, particular dressings, appropriated to the state of the injured parts, should be applied. I have already remarked, that in firm healthy constitutions, as soon as the discharge of blood which naturally occurs in large wounds is over, the parts come soon to be covered with a viscid coagulable effusion from the mouths of the retracted arteries; but in constitutions of an opposite nature, where the solids are much relaxed, the blood in general is in such a dissolved state as to afford no secretion of this kind.

In order to supply as much as possible the deficiency of this natural balsam, different artificial applications have been employed. Covering the parts with starch or wheat-flour has sometimes proved useful ; and I have known gum arabic, myrrh, and galbanum, in fine powder, prove successful when these have failed.

Applications of this kind, indeed, have been used with success in all such hemorrhagies, with whatever habit of body they are combined ; but they prove more particularly useful in relaxed constitutions, attended with a dissolved state of the blood, and an unfeebled muscular system. We may here also use a remedy which in circumstances of this kind very seldom fails ; but which, in those of an opposite nature, ought never to be employed. The remedy to which I allude is alcohol, or any other ardent spirit, impregnated with as great a quantity as it can dissolve, of myrrh, or any other of the heating viscid gums. The balsamum traumaticum of the shops, a remedy of this kind, has long been

been famed for its influence in such cases ; but the indiscriminate use of this, and remedies of a similar nature, which has long prevailed with some practitioners, I am confident has done much harm ; for, as they all act as stimulants, they of course tend to aggravate every symptom in wounds connected with tense fibres, when much pain, and especially when spasmodic muscular affections prevail. But, in constitutions of an opposite nature, where the blood appears to be in a dissolved state, and the arterial system seems evidently to require a stimulus, remedies of this class prove highly useful : Inasmuch that where the hemorrhagies in such constitutions prove distressful, no remedy answers better than lint, immersed in a balsam of this kind.

By due perseverance in this mode of treatment, hemorrhagies of this kind will for the most part be soon restrained : But when this does not happen, and when, notwithstanding of these, a discharge of blood still continues ; together with the
means

means that I have advised, an equal moderate pressure should be applied over the whole surface of the fore, and continued as long as the necessity of the case may indicate.

In finishing the dressings of wounds of this class, after the lint and compresses have been applied, a bandage should be adapted to the part in such a manner as to produce an equal pressure over the whole surface of the fore. But it sometimes happens, that no bandage can be made to produce the desired effect: In such cases, the hand of an assistant is our best resource. The hand being firmly applied over the dressings, so as to produce an equal pressure, will commonly succeed when no other remedy has any effect.

Having thus endeavoured to point out the most effectual means of putting a stop to hemorrhagies, we shall now proceed to consider the different modes employed by art for effecting a discharge of blood when indicated by the existence of some disease in the constitution.

C H A P-

CHAPTER VIII.

OF BLOOD-LETTING.

SECTION I.

Of Blood-letting in general.

BLOOD-LETTING, whether we consider it as to its influence on the system, or with respect to the nicety with which it ought to be performed, is perhaps one of the most important operations in surgery. From being so frequently practised, and every pretender to knowledge in the healing art being able to perform it, the public have been induced to consider it

it as trivial with respect to its execution ; but every practitioner of character will acknowledge, that, in order to perform it properly, the greatest nicety, steadiness, and accuracy, are required. Every other operation in surgery I have frequently seen well performed ; but I have seldom seen blood-letting with the lancet correctly done. When properly performed, it is a neat operation ; but when not done with exactness, it is the very reverse.

I do not here mean to consider the various causes which in different circumstances point out the propriety of abstracting blood from the system ; nor do I intend to enter upon a particular discussion of the different effects of general and topical blood-letting : These considerations, as being highly important, would of themselves extend to a great length, so that they will not be looked for in a system of surgery. All that is here intended, is to describe the various modes of performing the operation of blood-letting.

In

In all inflammatory diseases not entirely local, the method of taking away blood, as established by immemorial practice, is, by such means as discharge the quantity to be taken, at an opening made with a lancet, either in an artery or a vein. Whether there is any real difference in the effects which these two modes of discharging blood produce, it may be difficult, with precision, to determine ; but there is reason to think, that, independent of the quantity taken, the difference is of less importance than is commonly imagined. The latter of these termed Phlebotomy, and the former Arteriotomy, are the means employed for what we term General blood-letting ; the particular consideration of which we shall presently enter upon.

But it often happens in local inflammation, that little benefit is derived from general blood-letting, while considerable advantage is obtained from what we term Topical or Local blood-letting in which blood is discharged from the diseased part, by dividing a number of the small vessels
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by which it is supplied. The means employed for this I shall hereafter point out, while, in the mean time, we proceed to consider phlebotomy.

Wherever a vein can be reached with safety, an opening for the discharge of blood may be made in it with a lancet; but the following are the parts from whence blood is usually taken in this manner; the veins of the arm at the flexure of the cubitus; the jugular veins; and the veins of the ankles and feet. In particular instances, blood is also advised to be taken from the veins of the hand, of the tongue, and of the eyes, and penis, as well as other parts.

Some general observations relate equally to this operation in whatever part of the body it is practised; these I shall in the first place point out, and shall afterwards proceed to treat particularly of blood-letting in the arm and other parts.

I. In this as in every operation, the posture of the patient, as well as of the operator, merits particular attention, and it
ought

ought to be different, according to the effects that we wish to result from it.

In some diseases, it is the object of this remedy, to discharge a large quantity of blood without inducing fainting: When this is the case, and when from former experience it is known that the patient is liable to faint during the evacuation, a horizontal posture, either upon a bed or on a couch, should be advised, for every practitioner knows that fainting does not so readily take place in a horizontal posture, as when the patient is erect.

It sometimes, however, happens, that one material advantage expected from blood-letting, is its inducing a state of deliquium; as is the case in strangulated hernia, where a general relaxed state of the system proves sometimes useful. In all such circumstances, instead of a horizontal posture, the more erect the patient is kept, the more readily will fainting be induced. So that the particular object in view from the operation, must at all times determine this matter.

While

While we thus attend to the posture of the body, the particular position of the limb or part to be operated upon, must not be overlooked. In every operation, it is a point of importance, to have the patient seated in a proper light, but in none is it more material than in blood-letting. The best general rule that can be given for it, is, that the patient should be so placed, that the principal light of the apartment shall fall directly on the part to be operated upon, so that the vein to be opened may be made as apparent as possible. When clear day-light can be obtained, it ought to be preferred ; but when this cannot be procured, one or more candles should be used.

But, whatever may be the position of the part itself, and whether the patient is placed on a bed or a chair, the surgeon should always be seated. The operation may, no doubt, be done while the surgeon is standing: and it is perhaps most frequently performed in this manner: but it can never be done either with such steadiness

ness or neatness, as when the operator is firmly seated.

II. From the coats of veins being more flaccid than those of arteries, and from the circulation which takes place in veins being slow, an opening made in a vein will not discharge freely if the vein be not cut entirely across, unless the blood is stopped in its return to the heart by means of a ligature placed between the heart and that part of the vein in which the opening is made.

The patient being properly seated, our next step therefore is, by means of a proper bandage, so to compress the vein intended to be opened, as to prevent the blood from returning to the heart; and for the same reason, an equal degree of pressure, it is obvious, should be applied to all the other veins of the part; for, were this to be neglected, the communication preserved by the collateral branches would render the pressure upon any particular vein of little importance. But, besides producing a more free discharge of blood

than could be otherwise obtained, this pressure upon the veins, by causing an accumulation of their contents, tends to bring them more obviously into view, and consequently renders it easier for the surgeon to make a proper opening than might otherwise be in his power.

Although compression, however, to a certain extent, is necessary for the purposes of accumulating blood in the veins, and for afterwards discharging it at an opening made by the lancet, it is at the same time obvious that any considerable degree of pressure, instead of forwarding these purposes, would obstruct them entirely; for, if the pressure meant to be applied to the veins only, should be carried so far as to affect the arteries, all farther access of blood to the veins would be cut off, so that no discharge of importance would take place at any opening that could be made. Whenever we mean, therefore, to discharge blood in this manner, the pressure ought to be moderate: It should always be carried so far as effectually

ally to compress the veins, but never to such a length as to obstruct the circulation in the corresponding arteries. When we see that the pressure raises the veins more conspicuously into view, and if at the same time the pulsation of the artery is distinctly felt in the inferior part of the limb, we may then be sure of its being applied in a very proper degree, and that it should not be carried farther: For by the swelling of the veins we are sure that they are sufficiently compressed; and by the arteries continuing to beat, it is evident that a continued flow of blood passes into them.

III. The reflux of blood to the heart being in this manner cut off, we have next to advert to the best method of opening the vein. Different instruments have been invented for this purpose, but two only have been retained in use. These are, the Lancet and Phlebotomy. This last, on being placed immediately on the part to be cut, is, by means of a spring, struck suddenly

into the vein, and forms an opening of the exact size of the instrument.

The phleme, in various parts of Germany, has acquired some reputation, particularly in taking blood from the jugular veins : But various objections occur to it, so that it is not likely ever to be in general use : From the nature of the instrument, the deepness to which it should go, ought to be regulated before making use of it : Now, we know well that this can never be ascertained ; for we frequently find it necessary, after the introduction of a lancet, to go much deeper than was at first supposed to be requisite ; so that when a phleme is used, unless we employ one in every instance of a length which cannot be frequently required, disappointments must often take place.

But the most material objection to this instrument is, that where arteries or tendons lie beneath the veins, and in danger of being hurt in the operation, the risk is much greater with the phleme than with the lancet : For when the lancet is used,
after

after the vein is opened, the orifice may be enlarged at pleasure without any additional risk, merely by carrying the instrument forward along the course of the vein, at the same depth to which it was at first introduced ; whereas the phleme, after entering the vein, must pass directly down to its full depth ; which adds greatly to the risk of wounding the parts underneath.

Besides, in using a lancet, we have it more in our power to command an orifice of a determined size, than with the phleme : So that, without hesitation, we may venture to pronounce the phleme to be an instrument in no degree necessary ; but, for such as incline to use it, the most convenient form of one is represented in Plate VI. fig. 4.

The manner of using the phleme is this. The bandage for producing the turgescency of the veins being applied in the manner already directed, the point of the instrument *A*, with the spring properly bent, must be so placed upon the part of the vein

to be opened, that an orifice of an oblique direction may be made in it on the spring *B* being let loose. The subsequent management is the same here as when the lancet is used, and will be presently pointed out.

In using the lancet, the form of the instrument is a point of the first importance, although it seldom meets with that attention which it merits : The form of lancet in ordinary use, represented in Plate VI. fig. 3. should never be employed in blood-letting : It is well calculated for opening abscesses ; but it ought never to be used in this nice operation.

The most obvious objection to this form of lancet is, that the broadness of its shoulders makes a wound in the external teguments, perhaps three times the size of the opening made in the vein ; which adds no advantage to the operation ; while it gives much unnecessary pain in the first instance, at the same time that it often renders it difficult to stop the flow of blood : I may also mention, that the wounds made by it
are

are so extensive, that they are apt to terminate in partial suppurations, which always prove both disagreeable and painful to the patient.

The spear-pointed lancet, represented in Plate VI. fig. 1. and 2. is an instrument well calculated for the purpose of venæ-section. From the acuteness of its point, it enters the vein easily, a circumstance of no small importance with many: It makes the opening in the vein nearly equal to the orifice in the teguments; and the discharge of blood at an opening made with one of these lancets, is commonly stopped with ease, immediately on the ligature being removed.

For these reasons, the spear-pointed lancet should be preferred; and although, with timid practitioners, the acute point of this instrument may appear to render more dexterity necessary in using it than the broad-shouldered lancet; yet the difference in this respect is so inconsiderable, that all who give it a fair trial will soon be able to use it with equal freedom.

dom. Indeed no surgeon ought to be trusted in letting blood with the one, whose steadiness and dexterity would in any degree be doubted with the other.

IV. The form of lancet being thus fixed on, we come now to speak of the method of using it. The surgeon and patient being both properly seated, and the ligature applied, that vein should be made choice of, which, while it appears sufficiently conspicuous, is not so loose as to roll, on being compressed: Some veins, although they rise sufficiently, yet roll so much, that they are more difficult to open than others which lie at a greater depth. That vein, therefore, is to be preferred, which not only rises, so as to become obvious, but which appears to be connected with some degree of firmness to the contiguous parts. It is scarcely necessary to observe, when a vein appears to be so immediately connected with a contiguous artery or tendon, that there must be some risk of injuring these parts in the operation, if another vein not liable to such hazard

zard can be procured, it ought undoubtedly to be preferred.

Veins may lie directly above both arteries and tendons, and yet no manner of risk be incurred in opening them, provided the operator is sufficiently steady and attentive; but it must be admitted, that in some instances veins are so nearly and intimately connected with these parts, as to render it hazardous even for the most dexterous surgeon to attempt this operation.

The vein being at last made choice of, the surgeon, if he is to use his right-hand in the operation, must take a firm hold of the member from whence the blood is to be drawn, with his left, and, with the thumb of the same hand, he must now make such a degree of pressure upon the vein, an inch and half or two inches below the ligature, as not only to render the skin, and teguments tense, but at the same time to interrupt all communication between the under part of the vein, and that
portion

portion of it lying between the ligature and thumb placed as thus directed.

The lancet being bent to somewhat more than a right angle, the operator must now take it between the finger and thumb of his right-hand; and, leaving at least one-half of the blade uncovered, must rest his hand on the middle finger, ring finger, and little finger, all placed as easily as possible near to the vein from whence the blood is to be taken; and having pushed the point of the instrument freely through the skin and teguments into the vein, he must now carry it forward in an oblique direction, till the orifice is of a proper size; taking care, during the time of pushing on the lancet, that the point of it be kept in as straight a direction as possible, to prevent it from injuring the parts below.

The instrument is now to be withdrawn; and the surgeon removing the thumb of his left hand, the vein must be allowed to empty itself freely into cups provided for the purpose.

It

It is here of importance to observe, that the limb should be kept steadily in the same posture during the whole time that the blood is flowing off; otherwise, the orifice in the skin is apt to slip over the opening in the vein; a circumstance which always proves inconvenient, and in some instances exceedingly troublesome, by the blood from the vein passing into the surrounding cellular substance.

In taking hold of the lancet, I have directed the scales to form rather an acute angle with the blade of the instrument. It will even answer when they are more widely separated; but a farther separation proves always troublesome, by throwing the scales too much back upon the hand of the operator.

The length of instrument that ought to project before the finger and thumb, is another circumstance requiring attention; for unless a sufficient quantity is left uncovered, the surgeon cannot act with freedom. In lancets of an ordinary length,
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one half of the blade, as I have mentioned already, should always be left out.

The entry of the lancet into the vein is the next circumstance deserving notice ; and it is readily discovered ; for as soon as the point has entered the vein, the resistance to its farther progress is immediately diminished, and as soon as the opening is in any degree enlarged, the blood begins to rush out, and thus gives the clearest proof of this part of the operation being complete. On being thus rendered sure that the lancet has got into the vein, I have also desired that it may be carried forward in an oblique direction, taking care to keep the point of it in the same elevation from the instant it has passed fairly through the coats of the vein ; and to this part of the operation the most particular attention is required. To the want of caution in this important point, much of the risk attending this operation may be assigned.

The propriety of an oblique direction for the course of the orifice is obvious :

For,

For, when quite longitudinal, the sides of the wound are apt to close, so as not to admit of a free discharge; while, on the other hand, when the vein is cut entirely across, troublesome consequences commonly ensue from the wound being difficult to heal: An orifice somewhat oblique with respect to the course of the vein, is therefore preferable to either. But the material circumstance to be kept in view, is the direction of the point of the lancet after it has got fairly into the vein. By almost every author who has written on blood-letting, as soon as the lancet has got into the vein, in order to extend the orifice to a sufficient length, we are directed, very properly, to carry the instrument forward: But in what manner are we desired to do so? By raising the heel of the lancet, as it is termed, at the same time that the point and edge of it is in some degree pushed forward, so as to make the point of the instrument the centre of motion.

The reason of this last direction is, that the internal orifice of the vein may
not

not be farther extended upwards than the external wound in the skin and other integuments ; ecchymoses, or effusions of blood into the cellular substance, being the frequent effect of a different management when broad shouldered lancets are used : But when the spear-pointed lancet is used, this may be always avoided ; as, from the narrow point of the instrument, it may with safety be carried on in the cavity of the vein as far as is necessary. When the operation is properly done, the orifice in the vein must be nearly of the same extent as the wound in the skin ; and by the same management we avoid that important risk which must always occur from an implicit obedience to the direction I have mentioned : for one certain effect of raising the heel, or back part of the lancet, is, that the point must in the same proportion be depressed ; and the consequence of lowering the point, already perhaps sliding along the under side of the vein, must in all such circumstances prove extremely hazardous : For
if,

if, in this situation, the point of the instrument is depressed, which must undoubtedly happen when the heel is elevated, it must for certain pass through the back-part of the vein; so that if either an artery, nerve, or tendon, lie contiguous, they must of necessity be wounded; and I am perfectly convinced, that this alone has often been the origin both of wounds in the arteries, and of pricks in the nerves and tendons. This practice, therefore, as being highly dangerous, ought in every instance to be laid aside.

The size of the orifice in blood-letting should at all times depend on the nature of the disease for which the evacuation is prescribed. When it is meant to discharge a large quantity of blood suddenly, either with a view to excite fainting, or for any other cause, the orifice ought to be large; but in common practice, no necessity occurs for this.

In using a spear-pointed lancet, an orifice of an eighth part of an inch in length will in general answer every purpose; but
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when a broad-shouldered lancet is used, an opening of twice that size becomes necessary ; for with this instrument the orifice in the vein will seldom be more than half the extent of that in the skin.

After withdrawing the lancet, I have desired that the thumb of the left-hand should be removed from the spot on which it was placed : It may perhaps appear that some circumstances are here pointed out, with unnecessary minuteness, and this among others may possibly be considered as one : But it must be remembered, that the whole of this work is chiefly meant for beginners, to whom every circumstance in operations of importance ought to be explained : Now, one material use of the thumb placed below the point where the lancet enters, is, to keep the parts firm, so as to prevent the vein from rolling. But another advantage derived from it is, that by making a sufficient degree of pressure upon the vein, it prevents any blood from escaping between the time of removing the lancet, and the application of a cup for receiving

receiving the blood. During this period a good deal of blood is often discharged, to the great annoyance both of the patient, the operator, and bystanders; a circumstance which, with due attention, may very commonly be prevented.

V. When the vein is properly cut, and the orifice made sufficiently large, there is seldom any difficulty in procuring all the blood that is wanted. But we are in some cases disappointed in this, either from the orifice of the skin having receded from the opening in the vein, or from the patient having become faintish; circumstances always unfavourable to a free discharge of blood. When it happens from fainting, a stream of fresh air should be admitted to the apartment, wine or some other cordial should be administered, and the patient should be placed in a horizontal posture. By these means he will in general soon recover; but if still the blood should not flow freely, the member should be placed in every variety of posture that may tend to bring the open-

ing in the skin to correspond with that of the vein, which will soon be known to have happened by the blood beginning to flow. Throwing the muscles of the part into constant action, by giving the patient a cane, or any other firm substance, to turn frequently round in his hand when the operation is done in the arm, will often excite a constant flow of blood from a vein, when all other means have failed: And, lastly, when the pulse in the inferior part of the member is feeble, and cannot be easily distinguished, we may judge that the ligature is too tight, and may have it in our power to excite an immediate flow of blood, by removing or lessening the compression thus improperly made upon the arteries.

VI. A quantity of blood proportioned to the circumstances of the case, being thus discharged, the pressure upon the superior part of the vein should be removed; and this being done, if the spear-pointed lancet has been used, all further discharge of blood will in general stop. It sometimes, however,

however, happens, that the blood continues to flow freely even after the ligature is removed. When this is the case, the operator should compress the vein both above and below the orifice with the finger and thumb of one hand, so as to prevent any farther loss of blood: This being done, the limb should be washed, and entirely cleared of blood: The orifice must also be cleared of every particle of blood, and the sides of it being laid exactly together, a piece of court-plaster, or any other that is sufficiently adhesive, should be so applied as to retain them. This will in many instances render a bandage unnecessary; but when the blood has issued with much violence during the operation, and has been difficult to stop after the removal of the ligature, in such instances it is right to apply a small compress of linen over the plaster, and to secure the whole with a roller round the limb.

Before applying the plaster, I have directed the orifice to be cleared of every particle of blood; a circumstance, I may

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remark,

remark, of more importance than is commonly imagined: By inattention to this point, and want of exactness in closing the orifice, painful swellings and consequent suppurations are often induced, which with ease might be prevented. When the operation is properly done, the wound heals by what surgeons call the First Intention, that is, by the parts adhering without the formation of matter; but this can seldom happen, if the lips of the sore have not been neatly laid together after all the blood has been cleared away.

There is still another important argument for neatness in this matter. Among other troublesome consequences arising from blood-letting, inflammation sometimes occurs in the cavity of the vein; and as nothing tends more to produce this than the admission of air, this circumstance of itself strongly points out the propriety of attention to the point in question. For although inflammation in the internal surfaces of veins is not frequent, yet in various instances it is met with; and as the consequences

consequences arising from it, if suppuration ensues, must commonly prove fatal, they ought in every instance to be strictly guarded against.

VII. We come now to treat more particularly of some troublesome consequences which occasionally proceed from blood-letting, and which every operator ought to be as much as possible prepared to obviate. The most material of these are, tumors produced by blood effused from the orifice of the vein into the surrounding cellular substance; wounds of the artery lying contiguous to the vein; pricks of the nerves and tendons; and lastly, inflammation, induced in the internal cavity of the vein, as has just been mentioned. These we shall, under separate heads, proceed to consider*.

G 3 S E C.

* Among other reasons which I have given for preferring a spear-pointed lancet, it was observed, that with it the operation is done with less pain than with the broad-shouldered lancet: And the prevention of pain is of such importance, that nothing should be omitted that can in any degree tend to insure it.

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SECTION II.

Of a Thrombus, or Ecchymosis.

I HAVE already desired, that in blood-letting, the member should be retained in the same posture, till the whole quantity of blood intended to be taken is discharged.

In every operation our instruments should be in the most complete order ; but in none is this of more importance than in blood-letting. Well-tempered lancets will answer tolerably well after being frequently used ; inso-much that I have heard even well-employed surgeons assert, that they have used one or two lancets only during the course of many years' practice, without their ever being in the hands of a cutler. But it is certain, that every time a lancet is used, it must be more or less injured ; and as the prevention of pain is with most patients a point of no small importance, I think it ought to be laid down as a rule not to be departed from, never to use the same lancet twice, without putting it into the hands of a cutler. This I have long been in the practice of doing, not only with lancets, but with every cutting instrument ; and the trouble and expence attending it is inconsiderable, when compared with the advantage derived from it.

charged. When this is neglected, a small tumor is apt to form immediately above the orifice in the vein, by the blood insinuating into the cellular substance of the neighbouring parts. This kind of tumor, when round and small, is termed a Thrombus; and when more diffused, an Ecchymosis.

Immediately on the appearance of these swellings, the ligature should be removed; and the member being put into that posture in which it was held when the lancet was introduced, the ligature may be again renewed. A free return of blood will probably in this manner be induced; by which, if the tumor be not entirely removed, it will at least be prevented from becoming larger.

It sometimes, however, happens, that these swellings come at once to such a size, as entirely to preclude every possibility of finishing the operation at the orifice first made in the vein. Even here, however, the ligature should be immediately removed as the most effectual method of pre-

venting an increase of the tumor. By continuing the bandage on the vein, as is often done, the blood still continues to be forced into the surrounding cellular substance; by which, such degrees of swelling are induced as are apt to create a good deal of trouble, which, with due attention, might, in every instance, be prevented.

In this situation, it would be vain to expect any considerable quantity of blood from the orifice first made. The only way in which the operation can be completed, is by making another opening, not in the same vein, which in such circumstances would seldom bleed freely, but in any other that lies most convenient.

When these tumors do not become large, they are for the most part easily dispersed: In this state, indeed, they seldom require attention; but when they become larger than usual, an immediate application of discutients should be advised. Astringents are to be more depended on than any other remedy, and of this class brandy and other ardent spirits are perhaps as useful as any.

Compresses,

Compresses, wet in a solution of crude sal ammoniac in vinegar, and applied with moderate pressure, have likewise proved effectual.

Instances, however, sometimes happen, although not frequently, of the collection of blood being in too great quantities to admit of being all absorbed: In such cases, as no suppuration can happen, from nothing but red blood being contained in the tumor, which cannot be converted into purulent matter, it ought to be immediately laid open as soon as there is reason to suppose that no farther diminution of size will probably occur from absorption. This being done, and the coagulated blood evacuated, the sore falls to be treated like any ordinary wound.

But these tumors are in general of little importance when compared with other accidents which sometimes proceed from blood-letting. The first of these of which we are to treat, are wounds of arteries.

SECTION III.

Of Wounds of the Arteries.

IN all the smaller arteries, openings may be made with little or no risk; but we know from experience, that wounds in the larger arteries often prove hazardous, and seldom heal easily.

When, in blood-letting, we have reason to suspect that an artery has been wounded, by the lancet having passed through the vein, and that blood is discharging at the same orifice, both from the artery and vein, it becomes a matter of importance for an operator to know with precision whether it is so or not. There is only one way in which complete certainty can be obtained on this point; and it is this:

When the blood comes from the vein only, if a degree of pressure is applied both immediately above and below the orifice
sufficient

sufficient for compressing the sides of the vein, all farther evacuation of blood should instantly stop, even when the pressure is not so considerable as to affect the artery below; but if part of the blood comes from a wound in the artery, this pressure upon the vein, instead of putting a stop to the discharge, will rather tend to increase it. When at the same time the blood is discharged *per saltum*, this will no doubt serve as a farther proof, but this test of itself, I may remark, is not so decisive as is commonly imagined; for, a vein lying immediately contiguous to a large artery, receives the influence of the arterial pulsation in such a degree, that any orifice made in it discharges blood very nearly in the same manner as if the artery itself was cut. No other proof, however, is necessary of the artery being wounded, than the one I have mentioned; for, if after the veins are thoroughly compressed, both above and below the orifice, blood should still flow with force, no doubt could remain of the artery being wounded. In
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all such trials, it is scarcely necessary to observe, that in compressing the veins, care should be taken not to affect the artery.

In such circumstances, it is the common practice to tie up the part with as much firmness as possible, in the first place with different compresses placed over the orifice of the vein; and lest these should not be sufficient, a piece of money or other hard substance is commonly added, and the whole secured with a roller very tightly applied. But what are we to expect from much pressure applied in this manner? It will not be said, that it should be so considerable, as to compress the artery itself; for, in that case, a stop would be put to the circulation in the whole limb: While, again, if the force is in such a degree as to compress the sides of the veins only, one certain effect of this must be, to occasion a considerable resistance to the flow of blood from the artery: and the blood being thus obstructed in its natural course, will necessarily be much more readily

dily effused at the opening in the artery, than if the veins had been all left free and pervious to receive and transmit it.

In all such cases, therefore, instead of applying much pressure, such means should be advised as will with most certainty tend to relax the veins; and in order to command the blood, the lips of the wound should be laid together, and retained by straps of adhesive plaster, without any bandage. And as there is not a more effectual method of relaxing the whole system, and the vascular system in particular, than by discharging large quantities of blood quickly, as soon as it is known that an artery is hurt, as much blood should be discharged by the orifice newly made, as the patient can easily bear. In this manner, and by enjoining strict attention to rest of body, in order to prevent as much as possible the undue action of the arterial system, and by keeping the body cool, with the use of gentle purgatives, a low diet, and farther blood-lettings when necessary, there may always be some chance

chance of such wounds in arteries being brought to heal : Whereas, when much pressure is made upon the veins, the blood being thereby prevented from flowing through them, must necessarily be forced out at the newly formed orifice in the artery ; and which must therefore, in the most certain manner, prevent it from healing : In this manner there is reason to think that many aneurifmal swellings have been produced, which, under the mode of treatment I have advised, would not have taken place.

In wounds of arteries, however, it frequently happens that no treatment whatever will succeed ; the orifice in the artery will not reunite, and blood in large quantities is effused into the contiguous parts. Even in this state of the injury, strong pressure is often advised, with a view to dissipate the tumor : But unless the swelling is soft, and the blood contained in it still remains fluid, no pressure whatever will disperse it ; for, whenever the
accumulated

accumulated blood has become firm, we cannot suppose that pressure will drive it back by the passage from whence it came. Nor does it appear, that in such circumstances, pressure tends to forward the absorption of extravasated blood. From theory alone we might be induced to draw this conclusion; and in fact I have not met with an instance of pressure in such cases affording any advantage.

There is indeed a variety of aneurism, formed by an artery being wounded by a lancet after passing through a vein, in which moderate pressure proves useful. When an artery wounded in this manner, lies quite contiguous to the corresponding vein, the opening between the vein and artery, in some instances, remains pervious after the external orifice in the vein is closed, so as to produce a direct communication between the one and the other; and the vein in this manner receiving the full force of the arterial pulsation, while its coats are not possessed of firmness sufficient to resist it, a swelling
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of the vein of necessity takes place. In all such instances, we may readily suppose, that moderate pressure will prove useful, by tending to support the distended vein, and thus preventing any farther increase of its bulk; but in no other swelling arising from blood effused from an artery, can pressure answer any good purpose; while, for the reasons I have enumerated, there is much cause to suspect that it has often done harm.

When we are certain that an artery has been opened, and that the tumor produced by it, arises from blood collected in the cellular membrane around it, if keeping the limb in an easy relaxed posture, and the veins free from pressure, together with the other means that I have pointed out, do not answer, no other mode of treatment will be productive of any advantage.

The tumor still continuing, by the communication between it and the artery being kept up, and none of the means employed

employed for dispersing it, proving effectual, the disease in this state is to be considered as an aneurism, a variety of tumor, of which we shall speak more particularly in Chapter IX.

SECTION IV.

Of Wounds or Pricks in the Nerves and Tendons.

WOUNDS of arteries, as well as those of tendons, ought never to happen in the hands of a good surgeon; for, as arteries and tendons may both be distinguished by the finger, and their situation thereby ascertained, it must always be the fault of the surgeon, if the point of his lancet is not so directed as to avoid them. One principal cause of these accidents in blood-letting, is, as I have endeavoured to show, the ordinary practice of depressing the point of the lancet, after it has entered the cavity of the vein. This, however, I have shown to be always unnecessary, and in many instances highly dangerous. But although, by proper attention to this part of the operation, we may always with certainty avoid the arteries and tendons; yet it may be said, that the nerves, which are so small as not
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to be previously distinguished, run at all times a great risk of being injured; and we know, that when wounded, the most alarming symptoms take place, that ever succeed to the operation of blood-letting.

But although the nerves cannot previously be distinguished, yet, if a proper direction is given to the lancet, so as to prevent the point of it from passing through the back-part of the vein, the same means which tend to secure the arteries and tendons, will, with almost equal certainty, prove a safeguard to the nerves: For, if the operator enters his lancet, as ought always to be done, on the superior part of the vein, and does not cut the vein entirely across, by pushing it through the opposite side of it, he will seldom or never injure the contiguous nerves: for the nerves, though they run near to the veins, yet they either lie immediately below them, or so far down upon their sides as to be out of all risk of being wounded, if

the orifice is made in the upper part of the vein only. I may venture to assert, that the nerves are never injured by a lancet entering the anterior part of a vein: It is always on the opposite side of the vein that any mischief of this kind is produced, when the lancet, as I have already observed, is pushed entirely through; which it ought never to be, and which every surgeon ought to have steadiness enough to prevent.

But although, with very ordinary care and attention, accidents of this kind may be guarded against, and although I have shown, that the surgeon is almost in every instance to blame when they take place; yet experience tends to evince, either from want of attention, or from want of steadiness on the part of the operator, that however easily such inconveniences might be avoided, yet still they frequently occur. Nerves, and even tendons, are sometimes pricked, when the dreadful train of symptoms which such accidents usually produce, are, of course, very apt to ensue.

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In some cases the patient complains of an exquisite degree of pain, instantly on the lancet being introduced; and this we may always consider as a certain mark of a nerve or tendon being pricked: With due care and attention, the violence of pain will often abate, and at last cease entirely, and no danger will ensue; but in some instances the pain, instead of abating, gradually becomes worse; the lips of the sore become hard and inflamed; and in the course of a day or two from the operation, a thin watery serum begins to ooze from the orifice.

If relief is not soon obtained, these symptoms generally continue in nearly the same state for several days: Thereafter the pain becomes still more distressful; but instead of being sharp and acute, it is now attended with the sensation of a burning heat. The fulness in the lips of the wound becomes more considerable, and the swelling in the neighbouring parts extends over the whole member, from the foot upwards over the thigh, when the

H 3 operation

operation has been done in the lower extremity ; and from the elbow down the fore-arm, and upwards along the humerus over to the pectoral muscle and other contiguous parts, when at the usual place of blood-letting in the arm.

The parts at last become tense and hard ; an erysipelatous inflammatory colour frequently appears over the whole ; the pulse by this time is generally hard and quick ; the pain is now intense ; the patient restless ; twitchings of the tendons occur ; in some a locked jaw supervenes ; and, all these symptoms continuing to increase, it most frequently happens, that the misery of the unfortunate patient is only terminated by death.

Blood-letting, from being so frequently practised, may by many be considered as an operation neither so difficult to perform, nor so dreadful in its consequences, as those that I have enumerated ; and it must be allowed, that they are not frequent ; but they happen often enough to evince the importance of this operation,

ration. In the course of my experience I have known many instances of blood-letting ending in death, and the dreadful train of symptoms I have mentioned occurred in all of them.

Different opinions have prevailed respecting the cause of these symptoms: By some they have been imputed to wounds of the tendons; while by others the tendons are supposed to be destitute of sensibility, and that the painful symptoms which sometimes succeed to blood-letting, proceed entirely from wounds of the nerves.

By Mr John Hunter of London, these symptoms are supposed more frequently to proceed from an inflamed state of the internal surface of the vein, than from any other cause. Such a state of the vein he has often traced in horses that have died of such symptoms from venesection, where the internal coat of the vein was always found much inflamed, not only in the neighbourhood of the part where the orifice was made; but in some along

the whole course of the vein, even to the heart itself. Some instances have also occurred, of the same appearances in the human body, where the veins after death were found highly inflamed. And on other occasions, inflammation having in this manner been once excited, suppuration has at last ensued from it; and the matter thus produced, being in the course of circulation carried to the heart, Mr Hunter supposes, that in such cases death may have been induced by that cause alone.

There can be no reason to doubt the fact held forth by Mr Hunter, that in such instances the vein in which the orifice has been made, has sometimes after death been found inflamed: But, however ingenious his arguments may be, for concluding that this state of the vein is the original cause of all the bad symptoms; and although we must allow, that inflammation of a vein must tend to aggravate all the symptoms previously induced by other causes, yet I think we may conclude,

clude, that it could not in any instance account in a satisfactory manner for their first production.

In all the instances of this dreadful malady which I have met with, the patient at the very instant of the operation, felt a severe degree of pain. In some cases, the violence of the pain was almost insupportable. Now, this we can never suppose to happen from the mere puncture of a vein; for although the coats of veins are not perhaps entirely destitute of feeling, yet we know that they are not endowed with much sensibility. This inflamed state of the veins, therefore, which in some cases has been observed after death, must be considered rather as the effect, than the cause, of these symptoms; and that they should frequently excite inflammation in the contiguous veins, is highly probable. In the course of a short time from the operation, when the febrile symptoms commence, such a degree of hardness and inflammation is induced over all the contiguous parts, that
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it would be surprising indeed if the vein, which is thus perhaps surrounded with inflamed parts, should not be inflamed likewise.

We may therefore consider this inflamed state of the veins as a consequence, rather than the cause, of these symptoms ; and of course we revert to the opinion of their proceeding either from the wound of a nerve or tendon.

Some have indeed attempted to show, as I have already remarked, that tendons are almost totally destitute of sensibility ; and therefore, that wounds of tendons can never account for the various symptoms which sometimes ensue from blood-letting.

There is reason, however, to think, that, in different instances, the same train of symptoms have been induced by each of these causes ; that in one instance a wounded nerve, and in others pricks of tendons, have given rise to them. Being decidedly of this opinion myself, I think every person must be so, who has attentively considered

considered the subject; but as the same method of treatment proves equally applicable, whether the disease has originated from the wound of a nerve or tendon, I do not think it necessary to enter upon a more minute discussion of the question. Having in a former section shown how such accidents may be almost always avoided, we shall now proceed to consider the means best calculated for preventing the symptoms coming to an alarming height, when it is discovered that, either from inadvertence or any other cause, the mischief has actually happened.

Whenever a patient, at the time of the operation, complains of an exquisite degree of pain, we may conclude that some parts have been wounded which ought not to have been touched. When this unfortunately happens, if proper attention is immediately given, much may be done to obviate the accession of those symptoms which otherwise will undoubtedly take place.

In

In order to prevent as much as possible the accession of inflammation and other symptoms, a large quantity of blood should be immediately discharged at the orifice newly made; the limb, for several days, should be kept in a state of perfect rest; care should be taken that the muscles of the part are preserved in as relaxed a state as possible; the patient should be kept cool; on a low diet; and, if necessary, gentle laxatives should be administered.

By this management alone, the fatal symptoms that I have enumerated, may frequently be prevented; and when they take place where these precautions have been omitted, we may often conclude that they proceed more from negligence in the subsequent treatment, than from any thing peculiarly bad in the nature of the original accident.

If, however, notwithstanding of the means that I have advised, the symptoms continue to increase, if the lips of the orifice turn hard and more inflamed, if the pain becomes more considerable, and especially

cially if the swelling begins to spread, other remedies must be employed: In this situation, leeches applied upon the lips of the wound, frequently give relief; and when the pulse is full and quick, it even becomes necessary to evacuate large quantities of blood, by opening a vein in some other part.

The external remedies usually employed here, are, fomentations and warm poultices; but I have seldom known any advantage arise from them: On the idea of their being able to induce a free and kindly suppuration in the wound, and having reason to think, from their effects in symptoms of the same kind arising from other causes, that they would prove equally useful here, I must own that in various instances I adopted the practice in the greatest possible degree. Unfortunately, however, the advantages resulting from it never answered my expectation; so that at last I was induced to make trial of very different remedies.

Although,

Although, on first entering on the free use of warm emollients, I did not particularly advert to the cause of their failure, yet I now think that it may be easily explained. The parts principally concerned here being almost entirely membranous, and being therefore, as I have elsewhere shown*, incapable of yielding purulent matter, a continued course of warm emollients, instead of producing the wished for effect, must probably render all the symptoms more severe; for when remedies of this class do not induce a free suppuration, they tend, by the heat which they convey, to act as a stimulus, and hence increase the inflammation: And in fact we find, that all these applications, instead of proving useful, rather do harm. The heat of the part is here one of the most distressful symptoms; so that instead of affording relief, any additional warmth rather tends to augment this very tormenting source of uneasiness. The lips of the wound, not
being

* *Vide* Chapter I.

being capable of yielding good matter, are, by the additional heat which warm poultices and fomentations convey to them, rendered still more hard, swelled, and of course more painful, and the swelling also becomes more diffused over the rest of the limb.

By Ambrose Paré, Dionis, Heister, and others, instead of emollients, oil of turpentine, tincture of myrrh, and other heating applications, are recommended. That these would not prove effectual, I cannot from experience pretend to say; for suspecting that they might prove too powerfully irritating to parts rendered already exquisitely sensible by disease, I have never ventured to use them: But I can from repeated experience assert, that cooling astringent applications afford much more ease, and prove much more effectual, than warm emollients; and of this class, the most effectual I have ever employed are the saturnine remedies: The parts affected being alternately covered with cloths wet with a solution of saccharum

rum saturni, and pledgets spread with Goulard's cerate, are kept more cool and easy than by any other remedy I have used.

In all such cases, therefore, as soon as a sufficient number of leeches have been applied, and have discharged freely, the swelling should be covered with pieces of soft linen wet in a saturnine solution; and these being kept constantly moist for the space of a few hours, should be succeeded by Goulard's cerate; and thus every part in any degree swelled or pained, should be alternately covered with one or other of these applications, as long as these symptoms continue.

The febrile symptoms must at the same time meet with attention: The patient should be kept cool, and on low diet: his skin should be kept moist with Dover's powder: gentle laxatives should be given when necessary, and if the pulse becomes full, hard, or quick, farther quantities of blood should be taken.

In violent degrees of pain, opiates should be freely given, and when twitchings of the

the tendons and other convulsive symptoms supervene, they become still more necessary. In order, however, to have much influence in this state of the complaint, they require to be given in full doses; otherwise, instead of proving useful, they constantly aggravate the symptoms, not only by increasing the heat and restlessness, but by rendering the system more irritable, and therefore more susceptible than it was before of the pain arising from the wound: Whenever opiates, therefore, are in such circumstances employed, the doses ought to be large.

It often happens, however, in this very alarming situation, either from neglect at first, or from an improper subsequent treatment with warm emollients, that opiates and the other remedies I have mentioned are afterwards used in vain: The fever, pain, and swelling of the parts, continuing, convulsive twitches of the muscles at last supervene, all tending to indicate the most imminent danger. In this situation, if we do not immediately employ the most

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effectual remedy, the patient must soon be cut off; and the only remedy from which any real advantage can ensue, is a free and extensive division of the parts in which the orifice producing the mischief was at first made. From the repeated experience of ages, we know, that much more pain and distress is excited by the partial division either of a nerve or tendon, than from their being cut entirely across. Now, the intention of this operation is to complete the division of the nerve or tendon that have been wounded by the point of the lancet, and which I am induced in all such cases to consider as the chief cause of the subsequent distress.

As the operation, however, is attended with much pain, and being put in practice for the removal of symptoms from which it is perhaps difficult to persuade the patient that any danger is to be dreaded, all the remedies I have mentioned should first be employed before it is proposed: But, at the same time, care should be taken, that the symptoms be not allowed to advance

advance too far before we advise it; for when the patient is much weakened by the feverish symptoms having continued long violent, neither this nor any other remedy with which we are acquainted, has much influence. As soon, therefore, as the remedies I have advised have been fairly tried, and are found to be inadequate, we should immediately propose a free division of the parts chiefly affected; and the manner of doing it is this.

As all the contiguous parts are now supposed to be much swelled and inflamed, it is impossible to get clear access either to the nerve or tendons, but, by means of a large and extensive incision; and as this cannot be done but with the risk of opening the contiguous arteries, the first step to be taken, is to guard against this occurrence by applying a tourniquet on the upper part of the limb. This becomes necessary, not only for preventing the loss of blood which would ensue from a division of any of the large arteries, but for preventing that interruption which would

otherwise happen from a constant discharge of blood from the smaller vessels during the operation. The tourniquet indeed is more particularly requisite for this purpose, than for any other; for although it is proper, by means of it, to guard against the danger of wounding any of the large arteries, yet, with proper caution, this may for the most part be avoided.

The tourniquet, then, being properly applied, a transverse cut should be made with a common scalpel, in the parts chiefly affected, and it should run in a direction exactly across the original orifice in the vein.

In no operation is it more necessary than in this, to act with freedom in laying the parts sufficiently open by a free incision. A small incision excites nearly the same pain with a larger cut; and it has this material disadvantage, of preventing the surgeon from proceeding in the future steps of the operation with that ease and expedition which the nature of the case very commonly requires.

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The skin and other teguments being thus freely divided, the operator must make one slight incision after another, taking care, if possible, to avoid the larger arteries and veins; and he is to go on in this way, to discover the wounded nerve; or if there is no possibility of doing so, he must still continue to proceed in this gradual manner, till he has divided every part between the skin and periosteum; the tendons, larger arteries, and veins excepted.

At this time the tourniquet should be loosened; when in all probability the patient will express much satisfaction at what has been done: For, if the part is thus divided which was originally pricked by the lancet, immediate relief will be obtained; while, on the contrary, if the pain remains violent, we may be thereby convinced that the mischief lies in one or other of the tendons. An accurate examination, therefore, should now be made, by clearing the parts with a sponge; and that tendon lying most contiguous to the

vein in which the orifice was made, will most probably either be found pricked, or in an evident state of inflammation; but at all events, whether any such appearances are discovered or not, there should be no hesitation in dividing that tendon which lies most contiguous to the vein; or if two or even three tendinous extremities should lie in the way, and are all therefore equally liable to suspicion, they ought all to be cut across: This being done, relief will for the most part be immediately obtained; and, at any rate, this being done, every attempt will have been made from which there could be reason to expect any advantage.

The parts being thus freely divided, the tourniquet should now be undone, and such arteries as have been wounded, should be secured with ligatures. The parts are then to be covered with easy dressings, and afterwards treated in the same manner as a wound from any other cause.

The means of relief which I have thus advised, if every circumstance be not duly weighed, may probably be considered as
severe;

severe ; for an incision in these parts, carried to such a depth, must no doubt be attended with much pain, while the division of one or more tendons will produce a partial lameness of the whole member : But if we consider for a moment the importance of the object in view, all such fears must immediately fall to the ground : It is not a trifling advantage we are in pursuit of, nor should such a painful operation be ever proposed but in the most urgent circumstances. In the present instance, however, the patient's life is obviously to depend on the event of this operation ; so that the most timid operator, if capable of reflection, must admit the propriety of putting it in practice ; and from the event of every case that has once advanced to the length for which I have advised this operation, it may with certainty be pronounced, that patients in such circumstances are in the utmost hazard ; so that in such a desperate situation, no remedy that affords any tolerable chance of a recovery, however pain-

ful it may be, can with propriety be condemned.

From reasoning alone, we might conclude, that in such circumstances no other remedy would prove so successful; but when the propriety of the measure is enforced by the successful issue of repeated trials, no argument adduced against it can meet with much attention. In various instances of less importance, I have known much advantage derived from this practice; and, in one instance, from bleeding in the median cephalic vein of the arm, the symptoms had got to such a height, and had so obstinately resisted every other remedy, that there was much cause to dread that death must have ensued, had it not been for the effects of a free and very deep division of the pained parts. The patient, from being in exquisite pain, and in imminent danger, experienced almost instantaneous relief; and the swelling, which had previously continued obstinate, began soon to abate, and a perfect recovery

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ry was obtained in much less time than could have been looked for.

There is not, therefore, a point in surgery, of which I am more convinced, than of the propriety of this operation in all such desperate cases as the one of which we have been treating; but to such as have not met with occurrences of this kind, the remedy proposed will not only appear to be too violent for the disease, but they will also be induced to consider the length of discussion I have gone into as more prolix than necessary: A single instance, however, of the dreadful symptoms induced by this kind of accident, will be sufficient to convince any one, of the subject we have thus been considering, being perhaps one of the most important in the department of surgery.

All that I have hitherto said on blood-letting, relates to the operation in general: I shall now proceed to consider the operation as it is done in particular parts; and first of blood-letting in the arm.

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SECTION V.

Of Blood-letting in the Arm.

BLOOD-LETTING is more frequently practised on the fore-part of the arm at the joint of the elbow, than in any other part. The veins are in general more conspicuous in this place; but no other reason can be assigned for it. On the contrary, the near contiguity of nerves, tendons, and large arteries to these veins, makes it more hazardous here than in other parts. From this, I have often been induced to consider our fixing on this part for the ordinary operation of blood-letting as a very important error; especially as blood may be drawn from veins in other parts, with the same ease as from those of the arm, and with less danger; particularly from the veins of the neck, hands, ankles, and feet.

Blood-

Blood-letting in the lower extremities has chiefly been confined indeed to a particular set of diseases, especially to those of females : But no good reason can be assigned for this ; for it is now known, that, in general blood-letting, the place from whence the blood is drawn, is of little importance, and that the effects of the operation depend almost entirely on the quantity discharged in a longer or shorter time.

Blood-letting at the arm may be safely performed by surgeons of steadiness and attention, as in the hands of such men there is little or no risk of the lancet going deeper than the vein, and in this case nothing bad can ensue : But in common practice, it would be better to fix upon some other part. It may almost always be done with ease in the hands, feet, and ankles ; and if the operation is properly performed, the same quantity of blood may be drawn from the veins of these parts, as from those of an equal size in any other part of the body.

But

But whether this idea should ever be generally adopted or not, it is at least certain, if the cautions I have pointed out are proper in other parts, they are much more so in the arm, where the veins lie so very contiguous to parts which cannot be wounded, but with the risk of producing symptoms of the most alarming tendency.

Having already considered the various steps of the operation of blood-letting, so far as they relate to it in a general view, in order to avoid repetitions, nothing will be mentioned now but what is particularly required in taking blood from the arm.

In applying the ligature for compressing the veins, it should be placed an inch or an inch and half above the joint of the elbow ; and, in order to prevent the ends of it from coming in the way of the lancet, the knot should be made on the outside of the arm. In general, one knot might answer ; but a slip-knot being made above the first, renders it more secure, and it is very easily done.

In

In making choice of a vein from whence blood is to be taken, the general rules we have laid down upon this point, in the first section of this chapter, must be kept in view. That vein which appears most conspicuous, at the same time that it rolls least under the skin, should in general be made choice of; but when an artery is found to lie immediately below, and quite contiguous to the vein, the operator, if not perfectly satisfied with his own steadiness, ought rather to prefer another. For the most part, however, the artery lies so low in this place, that the median basilic vein, under which it commonly runs, may be opened with safety; and as this vein is usually more conspicuous than the others, it is for this reason in general to be considered as the best. Besides, we prefer the median basilic, from its being less deeply covered with cellular substance than the cephalic or median cephalic; and by lying towards the inner part of the arm, it is more thinly covered with the tendinous expansion of the biceps muscle, than either of the others.

thers. From these circumstances, the operation is also attended with less pain in this than in the other veins ; a consideration which in every operation merits our regard.

In blood-letting at this part of the arm, although it may be done with the right hand, either upon the right or left arm of the patient ; yet we do it more neatly with the right hand upon the right arm, and with the left hand on the left arm of the patient ; and whoever attempts the contrary, must find that it cannot be done but in an awkward manner, as the operator cannot in any other way apply his hand properly to that part of the arm on which it ought to rest.

In corpulent people, the veins sometimes lie so deep as not to be discovered by the eye ; but when they are sensibly felt by the fingers, even although they cannot be seen, they may be opened with freedom. In a few instances, however, they can neither be distinguished by the eye, nor with the finger : In this case, the
ligature

ligature should be removed from the upper part of the arm, and applied about half-way between the elbow and wrist, by which the veins below will be brought into view; and wherever a vein can be evidently observed, there can be no danger in performing the operation. This I have often found necessary, nor has any inconvenience ever ensued from it.

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SECTION VI.

Of Blood-letting in the Jugular Vein.

INFLAMMATION of the throat and of the eyes, as well as other affections of the head, frequently require blood to be taken from the contiguous parts ; particularly from the external jugular veins : The manner of opening these veins is this :

There is only one ramification of the jugular vein, namely, the principal posterior branch, that can easily be brought so much into view, as to be with propriety opened ; and even this lies deeply covered, not only with the skin and cellular substance, but with the platisma myodes muscle, so that a good deal of pressure is required to raise it. With a view to produce this, the thumb of the operator is commonly placed upon the vein, so as to compress it about an inch or inch and half below where
the

the opening is to be made. This, however, is seldom sufficient, as the blood, on being stopped in its progress through this branch, finds an easy passage to the other veins; so that unless the principal vein on the other side of the neck is also compressed, the vein to be opened can never be fully distended. In order to distend it sufficiently, a firm compress of linen should be applied on the largest vein on the opposite side of the neck; and a garter, or any other ligature, being laid over it, a firm knot should be tied below the opposite arm-pit; taking care to make such a degree of pressure, as may put an entire stop to the circulation in the vein, which in this way is easily done, without obstructing respiration.

This being done, and the patient's head properly supported, the operator, with the thumb of his left hand, must make sufficient pressure upon the vein to be opened, while, with the lancet in his right-hand, he should penetrate at once into the vein; and, before withdrawing the instrument,

the orifice should be made sufficiently large for the intended evacuation. It may be proper to observe, that a larger opening is necessary in the neck than in the arm, otherwise the quantity of blood is procured with difficulty : And, besides, there is not here the same necessity for caution on this point that there is in the arm : for in the neck, we meet with no difficulty in putting a stop to the blood : after removing the ligature, all that is commonly necessary, even when the orifice is large, is to close it with a slip of adhesive plaster.

In order to bring the vein more clearly into view, so as afterwards to be able to open it with more accuracy, some have directed, that the skin, cellular substance, and muscular fibres covering the vein, should be previously divided with a scalpel. This, however, is unnecessary ; and it renders the operation both more painful and more tedious than when done with the lancet at once.

SECTION VII.

Of Blood-letting in the Ankles and Feet.

WHAT has already been said on the operation of blood-letting, renders it unnecessary in this place to be minute. When blood is to be taken from the veins of these parts, it will be readily understood, that our first object should be to compress the veins, so as to produce an accumulation of their contents. The ligature being applied sufficiently tight a little above the ankle-joint, all the branches of the vena saphæna, both in the inside and outside of the foot, come at once into view; and as this vein is every where superficial, being in general covered with skin only, wherever it appears conspicuously, it may with safety be opened.

With a view to encourage the discharge of blood, it has been a constant practice

in opening these veins, to immerse the feet in warm water immediately on the orifice being made. But this is a very inaccurate method, as the quantity of blood taken in this manner can never be ascertained, from being all mixed with the water: Neither is the assistance of warm water necessary; for when all the veins are sufficiently compressed, and the orifice of a proper size, I never find more difficulty in obtaining a full discharge of blood from these veins, than from those in other parts of the body.

On removing the ligature, however, the blood stops easily; so that a piece of adhesive plaster applied over the orifice, answers all the purposes of a bandage.

These are the several parts from whence blood is usually taken by venesection; but in some instances, where the contiguous parts have been particularly affected, it has been judged advisable to open the veins of other parts, as those of the tongue, of the penis, the eye, and the external hemorrhoidal veins. When blood is to
be

be discharged in this manner from the penis, the veins can be easily brought into view by pressure with a ligature ; but, in the tongue, in the hemorrhoidal veins about the anus, and other parts where compression cannot be applied, all that can be done, is, to make an orifice of a proper size in the most conspicuous part of the vein ; and if a sufficient discharge cannot in this manner be obtained, it may be necessary in such circumstances to put the parts in warm water ; and, for some time, to keep them immersed in it.

Having thus considered the various modes of discharging blood by venesection, we now proceed to arteriotomy.

SECTION VIII.

Of Arteriotomy.

WHATEVER advantages may in theory have been expected from Arteriotomy, and however keenly some may in their closets have given it their support, not only as being in many instances preferable to venesection, but as an operation perfectly safe; yet the most strenuous friends to the practice have shrunk from attempting it on large arteries. Instances, indeed, have occurred of large arteries being opened, and no dangerous consequences taking place; but they are so exceedingly rare, that no practitioner of experience will be induced by them, deliberately, or from choice, to adopt the practice. The smaller branches of arteries may indeed be opened with safety when not deeply covered, and especially

cially when they lie contiguous to bones ; for in these situations, as soon as the quantity intended to be taken is discharged, all farther loss of blood may be prevented by compression ; but the opening of any of the larger arteries must be always attended with so much hazard, and the advantages to be expected from it in preference to venesection are apparently so trifling, as must probably prevent it from ever becoming general.

We know of few arteries, therefore, which with propriety can be opened : the different branches of the temporal are those indeed from whence blood in ordinary practice is ever taken : but, if a fanciful practitioner should at any time incline to take blood in this manner from a different part, it may be done with safety from one of the arteries running on each side of the fingers. About the middle of the last phalanx, this artery is sufficiently large for discharging a considerable quantity of blood ; in most cases it lies superficial, and in this situation there can seldom be

much difficulty in putting a stop to the discharge: In performing this operation on any of the temporal branches, if the artery is superficial, it may be done with one push of the lancet, in the same manner as in venesection; but, when the artery is deeply covered, it should be previously brought into view, by cutting the skin before making the orifice with the lancet: For when the smaller arteries are cut entirely across, they never bleed freely, from their being apt to retract more or less within the surrounding parts.

Some nicety is therefore necessary in making the opening into the artery: It should neither be quite across, nor directly longitudinal; for it never bleeds so freely, either in an artery or vein, when quite longitudinal, as when somewhat oblique.

When the opening is properly made, and the artery of a moderate size, it will at once discharge freely, without being compressed; but the discharge may be increased at pleasure, by compressing the artery

tery immediately above the orifice, between it and the corresponding veins. The quantity of blood being thus discharged, a very slight compression on these smaller arteries will suffice for putting a stop to the evacuation: For the most part, any pressure that is necessary may be applied here as in venesection, by means of a linen compress and roller: the orifice being first entirely cleared of blood, and properly covered with adhesive plaster. If this should not prove sufficient, a compress of linen should be applied over it, and the whole secured with a roller.

In some instances even this does not succeed, and the orifice continues to burst out from time to time, so as to produce much inconvenience and distress.

In this situation we have different methods of putting a stop to the discharge. *1st*, If the artery is small, as all the branches of the temporal arteries commonly are, cutting it entirely across, exactly at the orifice made with the lancet, by allowing it to retract within the surrounding parts,

parts, for the most part proves sufficient. *2d*, When the patient does not consent to this, we have it always in our power to secure the bleeding vessel with a ligature, as would be done with an artery accidentally divided in any part of the body. And, lastly, when the patient will not consent to either of these, we may, by regular continued pressure, obliterate the cavity of the artery at the point where the opening was made, and thus produce an accretion of its sides. Different bandages have been contrived for compressing the temporal artery; but none of them answer the purpose so well as the one represented in Plate V. fig. 2.

As some time, however, is required to obliterate the cavity of an artery, this method is accordingly more tedious: but with timid patients it proves more acceptable than either of the other two.

Having thus considered the various means employed for evacuating blood from the larger arteries and veins, we now proceed to the consideration of topical blood-letting.

SECTION IX.

Of Topical Blood-letting.

WHEN, either from the severity of local inflammation, or from any other cause, we wish to take blood directly from the vessels of the part affected, the following are the different methods we employ for it. The application of leeches; scarifications with a lancet, or some other sharp instrument; and, lastly, by means of an instrument termed a Scarificator, containing from one to twenty lancets, or more: In this instrument, Plate VII. fig. 1. the lancets are fixed in such a manner, that when applied to the part from whence we wish to take blood, the whole number are driven suddenly into it, by means of a spring, and to a greater or lesser depth, at pleasure. This being done, as it is the smaller blood-vessels only that by this operation are ever meant to be cut, and as these seldom bleed freely,

freely, different means are employed for promoting the discharge.

Various methods have been proposed for this. Glasses fitted to the form of the parts, with a small hole in the bottom of each, were long ago contrived; and these being placed upon the scarified parts, a degree of suction was produced by a person's mouth, sufficient for nearly exhausting the air contained in them*. This accordingly was a very certain method of increasing the evacuation of blood, but as it was attended with a good deal of trouble, while it did not always prove sufficiently powerful, an exhausting syringe was at last adapted to the glass, which served indeed to extract the air contained in it, but being troublesome in the application, and practitioners finding it difficult to preserve the syringe always airtight, this part of the operation has for a considerable time been chiefly done by applying heat in such a manner to the glasses, as to rarify the air which they contain

* Celsus, lib. 2. cap. 11.

contain in a degree sufficient for producing a considerable suction. And as the instrument in this simple form answers the purpose in view, the use of the syringe will probably be laid altogether aside. The glasses for this purpose, it is evident, must be entire; for if the least communication is allowed between their cavities and the surrounding atmosphere, no effect will result from them.

Different methods are employed for thus applying heat to the cavity of the glass. By supporting the mouth of it for a few seconds above the flame of a taper, the air may be sufficiently rarified; but if the flame is not kept exactly in the middle, and is allowed to touch either the sides or bottom of the glass, it is apt to crack and fly in pieces. A more certain, as well as an easier method of applying the heat, is to dip a piece of soft bibulous paper in spirit of wine, and having set it on fire, to place it in the bottom of the glass, and, on the flame being nearly extinguished, instantly to apply the
mouth

mouth of the instrument upon the scarified part. This degree of heat, which may be regulated by the size of the paper, and which ought to be always in proportion to that of the glass, if long enough applied, proves sufficient for rarifying the air, and at the same time, if done with caution, never injures either the glass or the patient.

If the scarifications have been properly made, they instantly begin to discharge freely on the glass being applied: On being nearly full of blood, it should be taken away, by raising one side of it, or by undoing a screw fitted to a small opening in the bottom, so as to give access to the external air. When more blood is to be taken, the parts should be bathed with warm water; and, being made perfectly dry, another glass exactly of the size of the first, should be instantly applied in the same manner; and thus, if the scarificator has been made to penetrate to a sufficient depth, so as to have cut all the cutaneous vessels of the part, almost any
necessary

necessary quantity of blood may be obtained. It sometimes happens, however, that a sufficient quantity cannot be got at one place: In this case, we apply the scarificator as near as possible to the parts affected; and this being done, the application of the glasses must also be renewed, as before.

When we wish to discharge the quantity of blood quickly, two or more glasses may be applied at once on contiguous parts previously scarified; and the quantity of blood is more quickly obtained when the cupping-glasses are first applied for a few seconds upon the parts to be afterwards scarified. The suction thus produced by the glasses, seems to have some influence in bringing the more deep-seated vessels into nearer contact with the skin, so that more of them are cut by the scarificator.

A sufficient quantity of blood being procured, the wounds made by the lancets should be all cleared of blood: and a bit of soft lint dipped in a little milk or
cream,

cream, or spread with wax-ointment, applied over the whole, is the only dressing which they require: Dry lint is sometimes applied, but it not only creates more uneasiness, but renders the wounds more apt to fester than when previously covered with an emollient.

Although this operation is not difficult, yet a good deal of practice is necessary to perform it in a neat and successful manner; but with proper attention, any operator may soon do it so expertly as to be able in this way to discharge any necessary quantity of blood.

In some cases of local pains, and in others with a view to promote suppuration, an operation, termed dry-cupping, has been proposed, and in some instances practised with advantage: It consists in the application of the cupping-glasses without the use of the scarificator. In this manner, a tumor is produced upon the part; and, where any advantage is to be obtained from a determination of blood

to

to a particular spot, it will not fail to answer.

In Plate VII. is represented a scarificator, together with different sizes and figures of cupping-glasses, with which every operator should be amply supplied, so as to be able to adapt a glass to every part from whence it may be proper to discharge blood.

When the part from which blood is to be discharged is so situated that a scarificator and cupping-glasses can be applied, this method of taking it is preferable to every other; but it sometimes happens, that parts are so situated as not to admit of their application: Thus, in an inflamed state of the eye, of the nose, and other parts of the face, the scarificator cannot be applied directly to any of these parts. In such instances, leeches are commonly employed, as they may with safety be placed upon any spot from which blood can be taken.

In the application of leeches, the most effectual method of making them fix upon

a particular spot, is to confine them with a small wine-glass. Allowing them to creep upon a dry cloth, or on a dry board, for a few minutes before being applied, makes them fix more readily ; and moistening the parts on which we wish them to fix, either with milk, cream, or blood, tends also to cause them adhere more speedily than they otherwise would do. As soon as the leeches have come away, the ordinary method of promoting the discharge of blood, is to cover the parts with linen cloths wet with warm water, or even with dry warm cloths : In some situations, this is perhaps the best method we can employ ; but wherever the cupping-glasses can be applied over the wounds, they answer the purpose more effectually. When the situation and figure of the part will therefore admit of their application, they ought always to be employed.

Among other methods of performing local blood-letting, I mentioned scarifications

tions made with a lancet, or some other sharp instrument: This proves particularly useful in ophthalmia, and often gives immediate relief where general blood-letting has previously been tried in vain. By scarifying the turgid vessels of the eye, so as to discharge perhaps only a few drops of blood, more advantage is often obtained than from the discharge of a great quantity either from the jugular veins or temporal arteries: The mere division of the vessels has in such cases indeed been supposed to prove useful; but I have constantly observed, that the advantage derived from this operation, has been nearly in proportion to the quantity of blood that has been taken.

Different methods have been proposed for performing it. It may be done with the shoulder of a common lancet, but more neatly and more easily by instruments that I shall hereafter point out in Chapter XI. when speaking more particularly of diseases of the eye.

Among other methods that have been proposed for scarifying the bloodvessels of the eye, doing it with the beards of rough barley was at one period much extolled, and by some the practice is still continued. By drawing the beards over the surface of the eye, in a direction contrary to the sharp spiculæ with which they are furnished, a considerable discharge of blood may be produced. But the pain attending it is exquisite; and as it does not possess any superior advantage over the method of dividing the bloodvessels with a lancet, it is now deservedly falling into disuse.

I have thus finished the consideration of the various means employed in surgery for discharging blood from the system; and as the disease termed Aneurism, is most frequently the effect of an unguarded manner of performing one of the operations that I have just been describing, the farther consideration of the subject

ject cannot, perhaps, be any where more properly introduced than in this place, where one of the principal causes by which it is produced has been so lately treated of.

CHAPTER IX.

OF ANEURISMS.

SECTION I.

General Remarks on Aneurisms.

BY the term Aneurism, was originally meant, a tumor formed by the dilatation of an artery; but modern practitioners make the term apply not only to tumors formed in this manner, but to such as proceed from blood effused from arteries into the contiguous parts; a circumstance

cumstance which may take place either from the puncture or rupture of an artery.

A tumor, produced by the dilatation of the coats of an artery, is denominated a True Aneurism; and we term it a False Aneurism, where, by the puncture or rupture of an artery, blood is effused into the surrounding parts.

As the introduction of new appellations frequently leads to confusion, necessity alone can justify the attempt in the present work, therefore it will seldom be done; but as the treatment of Aneurism may be rendered more clear and distinct, by a change of terms applied to the different varieties of the disease, it would be culpable in an author not to propose it.

Where aneurism is produced by the dilatation of an artery, as the tumor is circumscribed, and contained within coats peculiar to itself, it may with propriety be termed an Encysted Aneurism; while the other, arising from blood spreading

among the neighbouring parts, may with equal propriety be termed the Diffused Aneurism.

As these two varieties of Aneurism are, in many circumstances, different from each other, it will be proper to consider them separately.

In the true or encysted aneurism, the tumor, when first observed, is commonly small and circumscribed; the skin retains its natural appearance; when pressed with the fingers, a pulsation corresponding with that of the artery below is distinguished; and by compression, the contents of the swelling, while they are yet soft and fluctuating, may be easily made to disappear.

When means properly calculated for the removal of the disease, are not soon put in practice, the swelling begins to increase, it becomes more prominent, and proceeds in a gradual manner to acquire a larger size. The skin and teguments, for a considerable time, retain their natural appearance; the patient does not complain

plain of pain ; the tumor continues of an equal softness ; and its contents are still compressible, yielding considerably, and in some instances disappearing entirely, on the application of pressure. At last, however, when it becomes large, the skin loses its ordinary colour, becomes pale, and, in the more advanced stages of the disease, even œdematous : The pulsation still continues ; but the tumor, although soft in some parts, yet in others is firm, and cannot be made to yield much to pressure, part of the contained blood having in this stage of the disease become hard by coagulation.

The swelling continuing to increase, at last becomes painful ; the skin turns livid, apparently verging to a state of mortification ; an oozing of bloody serum issues from the teguments ; and if gangrene does not take place, the skin cracks in different parts ; and now the force of the artery not meeting with much resistance, if the vessel is large, a period is soon put to the patient's existence, by the blood
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bursting out with such violence as to produce almost instantaneous death ; at least in the larger arteries of the trunk of the body, this is the ordinary event of aneurisms. In the extremities, however, the arteries are not so large as by their rupture to be capable of producing effects so immediately fatal ; and besides, we can here, by means of the tourniquet, effectually guard against this sudden termination of the disease.

In aneurisms of the larger arteries, the effects produced upon the neighbouring parts, by the constant pulsation and gradual augmentation of the tumor, are often surprising. The softer parts we might, *à priori*, expect to yield to a great extent ; but the hardest parts of the body, probably from their not being capable of yielding, evidently suffer more from the effects of this kind of pressure, than either membranes, muscles, or ligaments. Even the bones frequently undergo a great degree of derangement by the pulsation and distension of contiguous aneurisms : Sometimes

times they are separated entirely from each other at the different joints : In some instances they are elevated out of their natural situations ; and not unfrequently we find them entirely dissolved.

These effects of aneurism, however, are not common in any of the extremities : It is the strong pulsation of the aorta only, or of some of the larger arteries at no great distance from the heart, that can ever produce such important consequences. Sometimes, however, similar effects of an aneurism have been observed in the thigh, and upper part of the arm ; even the bones of these parts have been destroyed by aneurisms of the neighbouring arteries.

These in general are the appearances and termination of the encysted aneurism, to which, however, one exception occurs in a variety of the disease, to be hereafter described.

Various causes may tend to produce encysted aneurisms. 1. From daily observation we know, that partial debility frequently

frequently occurs in different parts of the system : Thus, there is nothing more frequent than œdematous swellings of the extremities, even in constitutions otherwise healthy ; and these swellings we justly suppose most frequently to depend on local weakness of the parts in which they occur. Now, why may not debility of a similar kind fall upon part of the arterial system ? and, if this should happen, it is easy to see how in almost every instance it must terminate in aneurism : For the force of the heart continuing the same, if any particular part of an artery has lost its tone, as it is thereby rendered unable to resist the pulsations of the heart, dilatation of its coats, must at these weakened parts necessarily ensue ; and as soon as a morbid enlargement of the cavity of an artery is thus commenced, as its power of resistance will be proportionally less, while the *vis à tergo* continues the same, the farther increase of the swelling is a consequence that of course must take place.

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This may be considered as the most frequent cause of aneurism not depending upon external violence. Aneurisms of the aorta, seem in almost every instance to arise from this cause; as well as all others that do not obviously proceed from external injuries.

2. The external coats of an artery being destroyed by a wound, a partial weakness of the part will thus be produced; and this must render it liable to be acted upon by the heart and other parts of the arterial system, in the same manner as if previously debilitated by disease.

In dilatations of an artery produced by this cause, the progress of the tumor is such as I have described: The blood, from being still confined within the coats of the artery, continues to form a circumscribed tumor. At first the swelling disappears upon pressure; but on advancing farther, part of its contents become so firm by coagulation, as to render it impossible by compression to disperse it. This variety of aneurism may sometimes arise
from

from other causes, but we meet with it most frequently from blood-letting in the arm ; by the lancet, after passing through the vein, going so deep as to divide the external coats of the artery without penetrating its cavity.

3. This variety of aneurism has also been produced by the matter of sores and abscesses proving so corrosive as to destroy the external coverings of the contiguous arteries: When this takes place, the same train of symptoms must occur, as if the outer coats of the artery had been destroyed by a sharp instrument.

4. The bones, muscles, and ligaments, give all some degree of support to the arteries which they surround ; so that the destruction of any of these parts must evidently tend to the production of aneurism : Indeed, the firmness and stability of parts naturally connected together, depends so much upon a sound state of the whole, that any one of them becoming weak and diseased, generally terminates in a diseased state of the others. In the thigh of a patient,

tient, where part of the muscles and other soft parts were destroyed by an extensive mortification, different aneurismal swellings occurred in the course of the femoral artery which had thus lost part of its support; and no other cause appeared to be concerned in their production.

5. I have already remarked, that in blood-letting at the usual place in the arm, arteries are sometimes wounded, by the lancet passing through the vein into the artery below; and when the artery lies in direct contact with the vein, the blood discharged from the orifice in the artery, passing directly into the vein, serves to keep up a communication between them.

A communication being in this manner produced between the artery and vein, and the coats of the vein not being able to resist the impulse of the artery, a preternatural dilatation of the vein must necessarily ensue: A tumor is accordingly soon produced, which at first is small and circumscribed, but at last it gradually extends both above and below the orifice; not only

ly along the course of the vein originally wounded, but in some instances over all the contiguous veins.

This variety of the disease was first accurately described by our celebrated countryman Dr William Hunter; and may with great propriety be termed the Varicose Aneurism. Since that period it has been frequently observed by others; so that its nature is now very generally understood.

Although the coats of the artery are here completely divided, yet, as the blood is contained within the cavity of the veins, this species of the disease is obviously a variety of the encysted aneurism; and as the method of cure coincides, in some circumstances, with that of other encysted aneurisms, the further consideration of the subject could not any where be more properly introduced.

In the Varicose Aneurism, the swelling is confined entirely to the veins. Soon after the injury is committed, the vein communicating immediately with the artery begins to swell: In a gradual manner,

ner, the tumor becomes more remarkable, and the anastomosing branches of the contiguous veins also become enlarged. This swelling of the veins may, by pressure, be made to disappear, the blood contained in them being in part pushed forward in its course towards the heart, while part of it is sometimes forced into the artery itself; and, when the tumor is large, the blood, when thus forced out of it, is heard to make a singular hissing kind of noise. This may be always considered as a very characteristic symptom of the disease; but as it is not met with in every case of varicose aneurism, it becomes necessary to point out such circumstances as more certainly serve as means of distinction.

In the varicose aneurism there is a tremulous kind of motion discovered in the dilated vein, attended with a particular kind of noise, as if air was passing into it through a small aperture.

If a ligature is applied upon the under part of the limb, immediately below the swelling, and tied so tight, as even to stop

the pulse in the under part of the limb, the swelling in the veins, on being removed by pressure, returns instantaneously on this being taken off, and does not appear to be affected by the ligature below ; which it undoubtedly would be, were it not for this direct communication between the trunk of the artery and corresponding vein.

If the swelling is removed, by pressing the blood forward to the heart, and a slight pressure is made with the point of the finger on the orifice in the artery, the veins remain perfectly flaccid ; nor does any swelling take place, till the pressure is removed from the orifice, when it instantly becomes equally large as it was before ; and this even happens, although the pressure on the artery is not so firm as to stop the circulation in the under part of the limb.

In like manner, if the trunk of the artery is compressed above the orifice, so as to stop the circulation entirely, that tremulous motion and hissing noise in the tumor

tumor ceases instantly; and, if the veins are now emptied by pressure, they will certainly remain flaccid till the compression upon the artery is removed. In some instances too, if two ligatures be applied, one an inch or two above, and the other as much below the swelling, and are made so tight, as to stop entirely the circulation of the blood in the tumor lying between them; if the swelling is now compressed, all the blood contained in it is made to pass into the opening in the artery, from whence, however, it instantly returns again, on the pressure being removed. This does not indeed always happen; but its not doing so, is no proof of the varicose aneurism not actually existing; for if all or several of the other leading circumstances of the disease which I have enumerated, ever take place, the nature of the tumor is thereby rendered evident.

In addition to other characteristic symptoms of the varicose aneurism, I may remark, that when the tumor has been of

such duration as to excite much dilatation of the veins, the trunk of the artery above the orifice generally becomes preternaturally large, while the branches below become proportionally small; and of consequence, the pulse in the under part of the limb is always more feeble than in the sound limb of the opposite side.

Having thus enumerated the ordinary appearances of all the varieties of encysted aneurism, together with the various causes by which they are produced, I shall now proceed to describe the symptoms and causes of the diffused aneurism, and shall conclude with considering the method of cure.

The Diffused, or what is commonly termed the False Aneurism, consists in a wound or rupture of an artery, producing, by the blood thrown out from it, a diffused swelling in the contiguous parts.

Some of the largest internal arteries are occasionally ruptured by severe bodily exertion; particularly those of the lungs. This probably happens from the arteries
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in this organ being surrounded with soft contiguous parts, which do not afford them much support; for in the external parts of the body, where the arteries are more firmly supported, accidents of this kind are seldom met with. But it is chiefly in that variety of aneurism, produced by wounds of the more superficial arteries, that surgery ever affords relief.

Among other consequences of blood-letting in the veins of the arm, I had occasion to mention wounds in the contiguous artery as one: In a few instances, by the treatment which I then pointed out, the bad effects which otherwise would result from it, do not take place by the wound in the artery being speedily cured. This happy termination, however, of these injuries, is so rare, that it can never with certainty be looked for.

When the puncture of an artery does not heal speedily, it will necessarily terminate in an aneurismal tumor; and the following is the usual progress which it makes.

A small tumor, about the size of a horse bean, generally rises just at the orifice in the artery, soon after the discharge of blood has been stopt by compression: The tumor is at first soft, and has a strong pulsation. It yields to pressure, but never in such a degree as that of an encysted aneurism: For, if it be not in the more advanced stages of the latter, the blood remains fluid, and can be easily pressed from one part of the cyst to another; whereas, in the diffused aneurism, the blood forming the tumor is at once extravasated; it soon coagulates, and thereafter becomes firm.

In this state of aneurism, if the swelling is not improperly treated by the application of pressure, it generally remains nearly of the same size for several weeks: It then begins gradually to increase; and if seated at the usual place of blood-letting in the arm, it now proceeds farther up than the orifice, and extends rather more inwardly than towards the outer part of the arm, probably from the expansion

expansion of the biceps muscle not being in this place so firm and compact as in the external and under part of the arm. This enlargement of the tumor proceeds, too, more quickly in some than in others, and in some the swelling is much more diffused and extended than in others.

Both these circumstances depend probably upon the same cause. If the blood poured out by an artery, is thrown into a very lax cellular substance, we can easily suppose, that its increase will not only be more rapid, but that the diffusion of the tumor will for the same reason be much more considerable, than when the artery is immediately enveloped with firm membranous or ligamentous parts, which do not so readily yield to the impulse of the blood. From this circumstance alone, indeed, there is such a difference in the progress of aneurism, that in some instances the tumor is many months, nay even years, in arriving at any considerable size; while in others the blood is so quickly poured out from the artery, as to

be diffused over the whole limb in the space of a few hours from the operation.

An unusual degree of laxity in the cellular substance has undoubtedly much effect in promoting this rapid diffusion of the extravasated blood; but the practice of applying tight pressure in wounds of arteries has, I am convinced, in all such cases, a very hurtful effect. In addition to what I judged it necessary to say upon this point in the Chapter on Blood-letting, I shall here observe, that if it was possible to make moderate pressure upon the orifice in the artery alone, some advantage might perhaps be derived from it; but in applying pressure to the artery of a limb, the corresponding vein must be all so much compressed, as to give much obstruction to the return of blood from the artery. And whatever tends to obstruct the reflux blood, must in the same proportion distend the wounded artery, and thereby increase the quantity of blood that escapes by the orifice. Many machines have indeed been contrived for compressing the
artery

artery without affecting the rest of the limb: But however much these may have been extolled by their inventors, none have hitherto answered the purpose of compressing the artery alone, without at the same time obstructing the circulation in the veins; insomuch that much harm has in different instances been produced by all of them.

Whoever may wish to make use of these instruments, will find various forms of them in Heister's System of Surgery, and in the works of Dionis and Platner.

Mr Dionis, an eminent French practitioner, although he recommends the application of pressure to wounds in arteries, yet relates a case which happened to a surgeon of his acquaintance, in which the bad effects produced by it were so strongly marked, as must convince all who carefully peruse it, of the general impropriety of this remedy.

A surgeon having in blood-letting opened an artery, the usual method of applying tight compression was immediately employed.

employed. By this the external discharge of blood was soon stopped : But blood continuing to escape from the orifice in the artery, it passed up towards the superior part of the arm, which it filled to such a degree, that on the operation for the aneurism, which was soon found necessary, being performed, upwards of four pounds of coagulated blood was discharged from it ; and for this purpose it became necessary to lay the parts open along the whole course of the arm *.

When, again, compression has not been applied, unless an unusual degree of laxity prevails in the surrounding parts, the swelling proceeds to increase in a more gradual manner : In becoming larger, it does not, like the true aneurism, become much more prominent ; but rather spreads and diffuses itself into the surrounding parts : By degrees it acquires a firm consistence ; and the pulsation, which was at first considerable, becomes always less in proportion to this difference of consistence, and

* Vid. Dionis's Course of Chirurgical Operations.

and to the increase which the tumor receives in size; insomuch, that in large aneurismal swellings of this kind, the pulsation of the artery is scarcely to be perceived.

In the first stages of aneurism, if the blood thrown out from the artery lies deep, the skin preserves its natural appearance, and does not change its colour till the tumor is much advanced. It frequently happens, however, that the blood is thrown out with so much violence at first, as to get into immediate contact with the skin; in which case the parts become instantly livid, as if tending to a state of mortification. A real sphacelus, indeed, has in some instances been induced where the extravasation of blood was considerable, and where the means best suited for its removal have either failed or been omitted.

It must, however, be considered as very culpable neglect, to allow a patient, from this cause, to incur the risk which always results from mortification; for the
hazard

hazard arising from operating for an aneurism, is inconsiderable, when compared with the danger of an extensive gangrene.

On the tumor becoming large, the patient, who at first did not complain of it, is now much distressed not only with severe pain, but with stiffness, want of feeling, and immobility of the whole limb: And these symptoms continuing to augment, if the tumor be not opened, the teguments at last burst; and if the artery is large, and effectual means be not immediately employed for preventing it, death will soon ensue, in consequence of the profuse hemorrhagy which necessarily must succeed.

I enumerated various causes, as being frequently productive, under certain circumstances, of the encysted aneurism: We also meet with some variety in the causes of the diffused aneurism.

I. Violent bodily exertion may be considered, as I have observed above, as the most frequent cause of the rupture of arteries seated internally; but as these do
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not properly belong to a work of surgery, I shall not here consider them further.

II. The corrosive matter of sores and abscesses, by entirely destroying the coats of contiguous arteries, may in this manner produce the diffused aneurism.

III. The sharp spiculæ of a fractured bone being pushed into a neighbouring artery, have in different instances produced aneurism.

IV. Violent blows have been known to produce this kind of aneurism. This, however, can scarcely happen any where but on the head, where the arteries lie more exposed than in other parts to the effects of this kind of injury, from their being here very thinly covered, and from a blow in this situation falling on the artery lying almost in close contact with a firm hard body, the cranium.

V. If the arterial covering of an encysted aneurism, should ever burst before the external teguments of the tumor, the blood contained in it would diffuse itself into the contiguous parts; in which case,

a real *diffused* aneurism would be formed. There is reason, however, to think that this seldom happens : So far as I have observed, the internal coverings of aneurismal swellings never burst first. The tumor proceeds to increase in a gradual manner ; and the teguments at last become so tense and overstretched, that they lose their tone entirely ; the skin becomes soft and œdematous ; in some instances, it becomes gangrenous ; and in others, although it retains its natural colour, yet its usual powers are as evidently destroyed as they usually are in the last stage of mortification. In this state, it generally remains for a longer or shorter period according to the strength of the arterial pulsation below. At last, however, the skin begins to crack, and a thin serum oozes out ; the edges of this small fissure in the teguments gradually separate ; and the contents of the tumor having lost a considerable part of their support, the force with which they are impelled, by degrees becomes too powerful for the remaining coverings,

coverings, which accordingly soon burst, so as to discharge their contents externally, without any effusion into the neighbouring parts.

I should therefore suspect, that authors, in writing on this point, have been mistaken: The Encysted, or True Aneurism, as it is termed, has been commonly supposed in its last stages to burst internally, and thus to produce the diffused or false aneurism; from what I have said, however, there is cause to presume, that this is at least a rare occurrence. The progress and termination of the encysted aneurism, in every case that I have seen of it, has been nearly as I have just described it to be; not by the arterial sac first bursting, but by a rupture of the external teguments after being much overstretched; the blood being soon thereafter discharged outwardly, and not effused into the surrounding parts. As it has been alleged, however, by very respectable authors, that the reverse of this has sometimes happened,

ed, I could not here avoid to consider it as one of the causes of diffused aneurism.

VI. The most frequent cause, however, of the diffused aneurism, are punctures with sharp instruments, such as swords, cutlasses, and the lancet; which last may be considered as the most frequent of any.

Under one or other of these heads, almost every circumstance may be comprehended, that can ever tend to produce aneurismal tumors.

It has unfortunately sometimes happened, that tumors of the aneurismal kind have been mistaken for abscesses and other collections of matter, and their contents of course have been laid open by incision. The consequences of this may be more readily conceived than described. With a view to prevent such a dreadful occurrence, it would be a point of the highest importance in practice to have such a set of diagnostic symptoms of aneurism set forth, as would with certainty determine the question. In the commencement of the disease, it may, for the most part,

part, be easily ascertained: At this time, the pulsation in the tumor is commonly so strong, and other concomitant circumstances tend so obviously to point out the nature of the disease, that little or no doubt respecting it can ever occur: But, in the more advanced stages of aneurism, when the tumor has become large, and has entirely lost its pulsation, nothing but a minute attention to the previous history of the case can enable us to judge of it with accuracy.

Those swellings, with which aneurisms are most likely to be confounded, are, soft encysted tumors, scrofulous swellings, and abscesses containing either purulent or other matter, situated either immediately above, or so nearly in contact with an artery, as to receive the influence of its pulsation: When a tumor of this description is nearly connected with a large artery, the pulsation which it receives from it is frequently so strong and distinct, as to render it impossible, from this circum-

stance alone, to form any just idea of its contents.

But there is one symptom, which, when connected with a strong pulsation in the tumor, may always lead us to determine with certainty that the swelling is aneurismal, and it is this; the contents of the tumor being made easily to disappear upon pressure, at the same time that they return instantaneously on the pressure being removed. But although the *presence* of this circumstance, when connected with other characteristic symptoms of the disease, may lead us to conclude, that a tumor is of the aneurismal kind, yet the *want* of it ought not to convince us that it is *not* an aneurism; for it frequently happens, particularly in the advanced stages of aneurism, that the contents of the tumor become so firm and compact, that no effect is produced upon them by pressure. Upon the whole, therefore, as in many instances of aneurism, no certainty can be obtained of its real nature; in all such cases, practitioners should lay it down as an establish-
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ed rule, to proceed as if the tumor was in reality of the aneurismal kind. By adhering to this, they may perhaps in a few instances be deterred from opening tumors, which it may afterwards appear might have been laid open with safety; but any lesser inconvenience which this may occasion, will be much more than compensated, if, even in a single instance, a surgeon is saved from those disagreeable feelings which he must experience if he should ever have the misfortune to open an aneurism instead of a collection of matter.

But it is in the trunk of the body only, it must be observed, or in the neck, axilla, upper part of the thigh or groin, that so much caution in the treatment of tumors of this doubtful nature can ever be necessary. For in almost every part of the extremities, and even in all accessible parts of the head, when a tumor of this description has become large, the operation for the aneurism should always be advised; for we are in all these parts possessed of a very

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certain method of preventing danger, namely, the application of the tourniquet in the extremities, and of pressure with the fingers on the head.

In forming a prognosis in cases of aneurism, three important circumstances chiefly require attention. The manner in which it appears to have been produced : The part of the body in which it is situated : And, lastly, the age, and habit of body, of the patient.

If an aneurism has come forward in a gradual manner, without any apparent injury being done to the part, and without having succeeded to any violent bodily exertion, there will then be reason to suppose, that the disease depends upon some local debility of the artery in which it is seated, or perhaps of the whole arterial system : In which last case, little or no benefit can ensue from any attempt that can be made ; as the operation for the aneurism being performed near to the tumor, there would be reason to fear, that the same cause by which it was produced here, ultimately

timately tended to produce similar dilations in other parts of the artery : Whereas, there is much cause to hope, if the tumor has been produced by a bruise, puncture, or other external accident, that the operation would not fail of success, provided the circulation of the part be not altogether destroyed by the ligatures to be put upon the artery.

In the Varicose Aneurism, we may in general venture on a favourable prognosis. In different instances, it has been found, that the tumor does not increase so rapidly in the varicose aneurism, as in other varieties of the disease ; that as soon as it gets to a certain length, it does not afterwards acquire much additional bulk, and that any inconvenience produced by it may be borne with ease for a great number of years.

It is in this alone, I may observe, that we derive any advantage in the treatment of aneurism from the discovery of this variety of the disease : And a very important discovery it is ; for by means of it a pa-

tient may be saved, not only from a very painful operation, but from the risk which must always attend the destruction of the principal artery of a limb. When a varicose aneurism becomes so large as to excite much distress, the operation should no doubt be advised; but as long as the inconvenience arising from it can be easily borne, the hazard which very commonly attends the operation, and which nothing but necessity ought to indicate, should certainly be avoided*.

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* In Volume II. Art. xxxvi. of the London Medical Observations, two cases are related of the varicose aneurism, by Dr Hunter. One of them at that time was of fourteen years standing, and the other had subsisted for five years, and no operation had been found necessary. And in Vol. III. of the same work, Art. xiii. a similar case of five years' duration is related by Dr Cleghorn.

As it has been alleged by some that no advantage is derived from the discovery of this species of aneurism, from their supposing that the usual operation is as necessary in it as in any other variety of the disease; and as in different instances the operation has been put in practice even in the incipient stages of the varicose aneurism, where no real necessity, I think, could occur for it; it
therefore

The site of the tumor is the next point of importance requiring our attention.

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therefore becomes a matter of such importance as to merit a very attentive inquiry : and it is with much satisfaction that I communicate the following facts, as they tend to establish with certainty, that in the varicose aneurism, the usual operation of obliterating the cavity of the artery, is seldom, if ever, necessary.

In a letter which I received from Dr Hunter, he says, " The Lady in whom I first observed the varicose aneurism is now living at Bath in good health ; and the arm is in no sense worse, although it is now thirty-five years since she received the injury." And the Doctor further observes, that he never heard of the operation being performed for the varicose aneurism, that was known to be such.

In a letter from Dr William Cleghorn of Dublin, he says, that the case of varicose aneurism above mentioned, as related in the 3d volume of the London Medical Observations, remains nearly in the same state as at the time that account of it was made out, which was at least twenty years ago ; only that the veins are rather more enlarged. The patient recovered, and the limb became nearly as strong and serviceable as the other. The man has all along continued his business as shoemaker, and has lately recovered from a sprain in the affected arm, which he received in lifting a heavy burden.

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When an aneurism is so situated that no ligature or effectual compression can be applied for putting a stop to the circulation, if the artery is large, there would be the utmost hazard in laying it open; as the patient might probably lose more blood than his strength could bear, before it could be secured. In aneurisms, therefore, that are so situated, particularly on any part of the trunk of the body, on the neck, axilla, or groin, there can never be a good foundation for a favourable

In a letter from Mr Pott, whose opportunities for observation were great, he says, "That he has met with three different instances of this species of aneurism, and that the operation never became necessary in any of them."

Among other instances of varicose aneurism which have appeared here, a young man from Paisley, who had the misfortune to meet with it several years ago, was examined by different surgeons of this place. The disease was clearly marked, and no operation was advised. In a letter from Mr William Hamilton, Professor of Anatomy in Glasgow, I am informed, that this man was lately serving in the Navy, where he undergoes great fatigue without any inconvenience from the aneurism, although it was then of thirteen years' continuance.

able prognosis. In such situations, indeed, the greatest danger is always to be dreaded: For the force of the arterial pulsation would at last be apt to destroy the coats with which the tumor is surrounded; and in such an event, the most fatal consequences might ensue.

The success of this operation must also prove doubtful in the superior parts of the extremities: But in the inferior parts of the arms and legs, it may be performed with a very fair prospect of success, even on the principal arteries; for after the great artery of a limb has crept along the upper part of it, a number of small branches are always sent out, which by anastomosing not only with similar branches below, but by their means with the under part of the large artery itself, these, in the event of the common trunk from whence they sprung being destroyed, come to dilate to such an extent as to carry on the circulation in the inferior part of the limb much more completely than could *a priori* be expected. We would not naturally

turally suppose, after the principal artery of a part has been obliterated, that the circulation would there be afterwards carried on with much force; and yet numberless instances have occurred, of the large brachial artery being completely destroyed by ligature, without being productive of much inconvenience to the parts below; and the same circumstance has also happened, where the operation for the aneurism has been performed on the trunk of the great femoral artery*.

From

* In one case, the operation for the aneurism was performed with the most complete success, on the trunk of the femoral artery, about two hand-breadths from the groin, by the late Mr Thomas Hamilton, Professor of Anatomy in Glasgow. And what rendered this case more remarkable, was, that after the trunk of the large artery was secured with ligatures, it was necessary to perform the operation again upon a small branch of an artery which had been wounded, even farther up than the principal trunk.

For some time after the operation, the limb remained colder than the other, and it was upwards of a week before any pulsation could be felt in the artery at the ankle. In two months from the operation, the wound was completely

From what has been said, therefore, it must appear, that when an aneurism is so situated, that compression cannot be applied so as to secure the patient from the loss of much blood when the artery is laid open, the operation should not be advised; and in such cases, the prognosis ought certainly to be very unfavourable. But, whenever an aneurism, produced by external violence, is seated on any of the extremities,

pletely healed, and the circulation and heat returned; and in a short time thereafter, the patient had so far recovered the use of his limb, as to be able to take very violent exercise.

These particulars I thought it right to communicate, as the case of this patient is one of a few well authenticated instances, of this operation having been attempted on the femoral artery so near to its origin; and the success attending it surely points out the propriety of the measure, in every aneurism, even of these parts, not evidently arising from general debility of the coats of the artery.

In Vol. III. Article xii. of the London Medical Observations, another instance is related of the operation for the aneurism having been performed on the trunk of the femoral artery, by Mr Burchal, surgeon in Manchester: the patient recovered, and the limb became nearly as strong and as serviceable as the other.

ties, where we are sure of commanding the circulation, the operation should always be advised, as soon as there is cause to suspect, that the tumor, if left to itself, might burst, so as to endanger the life of the patient.

The success of this operation, depending in a great degree upon the circulation afterwards going on in the under part of the member, our prognosis ought, *cæteris paribus*, to be more or less favourable, according as the tumor is seated high or low on the limb. For the risk of the circulation being hurt, is always in proportion to the height of the tumor: according as it is high or low, this risk is always increased or diminished.

But, lastly, whether an aneurism has been produced by an external injury, or by internal disease, and whatever may be its situation, the habit of body and age of the patient are circumstances meriting particular attention in the prognosis to be formed of the probable event of an operation: In no operation, indeed, are the advantages

vantages derived from health and youth more conspicuous than in this ; for in the earlier periods of life, all the softer parts accommodate themselves much more readily to every important change, than they ever do in the more advanced stages of life : In old age, all the animal fibres have acquired so much firmness and solidity, as to be rendered almost incapable of distention : This is particularly the case with the arterial system, some parts of which often proceed to a state of ossification : So that at this period of life, we may readily suppose, that the smaller arteries are rendered incapable of that degree of distention necessary for supplying the want of the principal artery of a part, which in the more early periods of life, they might with ease have done.

This operation having been performed with various success, even where the tumors were apparently similar, both in situation and other circumstances, various reasons have been suggested to account for it. With some the operation has succeeded,

ceeded, even under circumstances apparently more unfavourable, than with others where it failed. Thus it has proved successful, as I have lately remarked, in the trunk of the femoral artery, while in others, it has failed when done in the ham : That is, in the former the circulation in the under part of the leg was still preserved, and the patients recovered ; while, in the latter, where success might more readily have been looked for, the limbs remained cold after the operation, no return of circulation took place, mortification at last was induced, and the patients died.

From this variety of success attending it, we find very contradictory opinions held forth respecting this operation. While one condemns it, as seldom proving successful, if it be not in the very extreme parts of a member ; others assert, that it may be done even in the largest artery of a limb, and with great probability of success.

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This contrariety of opinion, however, may, I think, be explained, by what I have said concerning the age and habit of body of those on whom the operation is performed; for, to the different powers of distention with which the arterial system is endowed at different periods of life, the good or bad success with which it is attended, may, with sufficient reason, be often assigned. So that, although it may fail in an old infirm person, even in the under part of the leg or arm, we ought not to be thereby deterred from advising it, even in much higher situations, where the patient is young and healthy.

It may also be proper to observe, that in the ham the operation is seldom done so well as in the thigh: The artery lies so deep in the ham, that it is taken up with more difficulty; by which a considerable quantity of blood is often lost; the strength of the patient is in this manner exhausted; and hence he often sickens and dies, when otherwise he might probably have recovered.

Having

Having thus considered the usual appearances and causes of aneurism, together with the grounds upon which a just prognosis is to be formed, we shall now proceed to the method of cure.

S E C.

SECTION II.

Of the Treatment of Aneurisms.

PRESSURE has been indiscriminately advised in Aneurism, not only in the beginning of the disease, but in its more advanced stages. In a former chapter, on blood-letting, as well as in some parts of this, this subject has already been noticed : To these I must now refer ; and shall at present advert to such points only as were not before considered.

In the diffused or false aneurism, pressure has been advised, not only with a view to discuss the tumor ; but in order to produce a reunion of the wound in the artery : I have already made it appear, however, as pressure in such cases cannot be applied to the artery alone, without at the same time affecting the veins ; and as this, by increasing the resistance to the arterial pulsations, must

force an additional quantity of blood to the orifice in the artery, that in this way it must often do harm.

But although pressure should never be advised in any stage of the diffused aneurism, yet in some periods of the encysted aneurism, it may often be applied with advantage.

In the early stages of encysted aneurism, while the blood can be yet pressed entirely out of the sac into the artery, a bandage of soft and somewhat elastic materials, properly fitted to the part, will often prevent an increase of the tumor; and, in some few instances, by the continued support thus given to the weakened artery, complete cures have been obtained. In all such cases, therefore, particularly in the varicose aneurism, which I have already endeavoured to shew can seldom require the usual operation, much advantage may be derived from moderate pressure.

But although pressure to a certain degree has frequently proved useful in encysted

cyfted aneurifm, it ought never to be carried far; for tight bandages, by exciting reaction in the parts to which they are applied, inftead of anfwering the purpofe for which they were intended, have often the contrary effect. Moderate prefure, therefore, is more eligible than a great degree of it; nor ought it ever to be employed but as an eafy fupport to the weakened parts.

While we thus, however, advife compreffion, other means ought not to be omitted: The patient fhould be kept upon low diet; if the pulfe is full, blood fhould be taken; the bowels fhould be kept open; and all violent exercife, particularly of the injured part, fhould be carefully guarded againft. In the latter ftages of aneurifm, when much tenfion and pain are induced, opiates prove ufe-ful; and often indeed are the only remedies from which we obtain relief.

This courfe of treatment applies to every aneurifm for which the operation is not to be performed; whether this may

proceed from the seat of the disease rendering it inadmissible, or from any other cause: In such circumstances, indeed, an easy support by means of gentle compression; a low diet in order to prevent a plethoric state of the vessels; repeated blood-lettings when plethora actually exists; a total abstinence from exercise; and the use of opiates when indicated by pain; are the only remedies from which much benefit is ever likely to be derived.

Having thus pointed out the different remedies to be employed where the operation is not to be performed, I shall now proceed to describe the operation itself, a measure that becomes necessary when the means recommended for the previous treatment of the disease have failed, or when the tumor has made much progress before proper assistance is procured.

Our first step in this operation is, to obtain a full command of the circulation in the under part of the limb, by means of the tourniquet applied above.

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This being done, the patient should be so placed, that the diseased limb, on being stretched on a table, may be of a proper height for the surgeon, who ought to be seated during the whole course of the operation. The limb being in this situation properly secured by assistants, an incision is now to be made with a scalpel through the skin and cellular substance, along the whole course of the tumor; and in order to ensure sufficient freedom for the remaining steps of the operation, this external incision should be carried at least half an inch past each end of the tumor. No mischief can ensue from the first incision being free and extensive; and I have seen different instances of the surgeon, being much embarrassed in the subsequent steps of the operation, by timidity or ill-judged lenity in this part of it.

This being done, the surgeon usually proceeds in a slow cautious manner, dissecting away one layer of the membrane after another, till the artery itself is laid

bare. In this manner the operation is always tedious, for the thickness of parts with which the artery is covered, is often very considerable, by one layer of a membranous substance having formed after another, from the coagulable lymph of the blood contained in the tumor: but there is no real cause for this degree of caution, as the operation may be equally well performed, in a shorter space of time, and with much less pain to the patient.

As soon, therefore, as the external incision of the skin and cellular substance is completed, a lancet should be pushed into the sac, so as to make an opening sufficiently large for admitting one of the fingers: This being done, the fore-finger of the left hand should be introduced at the opening, when the sac should be cut from one end to the other, by running a probe-pointed bistoury along the finger from below upwards, and afterwards from above downwards, so as to lay the whole cavity open.

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The cavity of the tumor being thus laid open, all the coagulated blood is now to be taken out : For which purpose, a variety of scoops and other instruments have been invented, but no instrument answers this intention so well, and with so much ease to the patient, as the fingers of the operator.

The coagulated blood being removed, together with the membranous filaments usually found in aneurismal tumors, the cavity of the sac must now be dried with a small sponge, when the tourniquet should be made perfectly slack, in order to discover not only the artery itself, but the opening into it from whence the blood collected in the tumor has all along issued. This being done, we are next to employ proper means for preventing any farther effusion of blood into the sac. Various means have been proposed for this ; but they are all comprehended in those that follow :

I. Ligatures upon large arteries, having in some instances destroyed the circula-

tion in the under part of a limb, it was long ago proposed, on laying open the sac, to endeavour to finish the cure, by applying a piece of agaric or dry sponge to the orifice in the artery; and in some instances, vitriol and other astringents, were used for the same purpose.

II. Upon the same principle with this, namely, that of still preserving the circulation in the whole course of the artery, it was some time ago proposed by Mr Lambert, an eminent surgeon of Newcastle, to secure the orifice in the artery with the twisted suture *. A small needle being pushed through the edges of the wound, they are then to be drawn together by a thread properly twisted round the needle, in the manner I have advised when treating of futures †.

These methods, however, are both liable to objections: In the first place, neither
sponge,

* Vide London Medical Observations, Vol. II. Article xxx.

† Vide Chap. vi. sect. v.

sponge, agaric, nor any astringent with which we are acquainted, is possessed of such powers to deserve much confidence; for, although, in a few instances, they have put a temporary stop to hemorrhagies, they have seldom produced any permanent benefit. In almost every instance in which they have been used, the hemorrhagy has recurred from time to time, so as to prove highly distressful, not only to the patient, but to the practitioner; so that from this want of success, little or no attention is now given to remedies of this class.

With regard to Mr Lambert's method of stitching the orifice in the artery, it is certainly an ingenious proposal, and would probably, in most instances, put an effectual stop to all farther discharge of blood; but as it has hitherto been very seldom practised, farther experience of its effects must be obtained, before we can with propriety either receive or reject it. But if, in a matter of such moment, reasoning may be admitted, I would beg leave to observe,
that

that two material objections occur to it. One is, that in almost every instance of aneurism, the artery lies at the back-part of the tumor; so that when all the collected blood is removed, there is such a depth of wound, that it must be always difficult, and in many instances impossible, to perform this nice operation upon the artery, with that attention and accuracy, which, in order to insure success, it certainly requires. It has sometimes, indeed, happened, that the artery has been found on the anterior part of the tumor, in which case, the orifice would no doubt prove sufficiently accessible. This, however, is a rare occurrence, as in almost every instance of diffused aneurism the artery lies at the bottom of the tumor, the blood being collected between it and the common teguments; and accordingly I have seen several instances, in which, after the tumor was laid freely open, the artery was found to lie so deep as to render it impossible to perform this operation.

But

But there is another very important objection to this practice recommended by Mr Lambert. By introducing a needle through the sides of the orifice, and drawing these together with a ligature, the cavity of the artery must undoubtedly be at that point much lessened. Mr Lambert, indeed, in his account of the only case in which he performed this operation, acknowledges that the diameter of the artery was thereby diminished. Now, the passage of the blood being thus contracted at one point, the impulse upon that particular part must be very considerable: So that the very remedy employed for the cure of one variety of aneurism, must in all probability prove a powerful agent in inducing another; for the blood being thus obstructed in its usual course, there will be much hazard of a dilatation being produced immediately above the stricture from which an encysted aneurism is very likely to ensue.

I must fairly acknowledge, however, that all I have advanced, proceeds from reasoning

reasoning alone, for, as yet, I cannot speak of it from experience. But, if farther trials of this operation shall tend to show that the objections which I have stated against it are not well founded, no one will be more ready than I shall be to adopt it; for, if these objections were removed, I should consider this operation as deserving to be ranked among the most important improvements which in modern times surgery has acquired. In the treatment of aneurism by the common operation, if the principal artery of a limb is concerned, some risk is always incurred, not only of injuring the parts below in a most material manner, but even of destroying them entirely, by depriving them of the quantity of blood necessary for their support. Now, by Mr Lambert's improvement, an effectual stop is put to the farther evacuation of blood, while at the same time the circulation in the diseased artery is preserved; so that if farther experience of its effects shall evince, that the objections which I have stated against it
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are not well founded, it will deservedly be admitted as an important improvement in the cure of aneurism *.

III. Neither of these methods being to be trusted, I shall now proceed to describe the usual method of performing this operation, and it consists in obliterating the arterial cavity entirely with ligatures.

The artery being laid bare in the manner I have directed, and the coagulated blood carefully removed from the cavity of the tumor, on the tourniquet being made slack so as to bring the orifice in the artery into view, a probe should be passed into it, with a view to raise the artery from the contiguous parts, so that the surgeon may be enabled with certainty to pass a ligature round it without comprehending the contiguous nerves, which in general run
near

* Since the first editions of this Work were printed, this operation has been once performed in the Infirmary here; but although done with sufficient accuracy and attention, it did not succeed; and before a cure could be obtained, it was judged necessary to perform the operation in the usual way.

near to the large bloodvessels of the limb. By this precaution, the nerves may be always avoided; by which much mischief may be prevented, which otherwise would probably supervene. In aneurisms seated in the ham, or in the usual place of blood-letting in the arm, bending the joint of the knee or elbow, by relaxing the artery, renders this part of the operation more easy, than when the limb is kept fully stretched out.

The artery being thus separated from the contiguous parts, a firm, waxed ligature must be passed round it, about the eighth part of an inch above the orifice, and another at the same distance below. More than this is commonly advised, but much harm has arisen from the ligatures being passed so far from the orifice as is commonly done; for the risk of losing the benefit of anastomosing branches must always be in proportion to the extent of artery included between the ligatures.

The easiest method of introducing the ligatures, is by means of a blunt curved needle,

needle, of the form represented in Plate V. fig. 3. A common sharp needle is usually employed ; but it does not answer the intention so well. Being sharp in the point and sides, it is apt to injure the contiguous parts ; and when the common crooked needle is used with a sharp edge on its concave side, there must even be some risk of wounding the under part of the artery, as the needle in this situation can scarcely be introduced without being in contact with the coats of it. The blunt needle is not liable to either of these objections ; and besides, when of the form represented in the plate, it is more easily introduced than any of the needles commonly used in this operation. Of late a new instrument has been proposed instead of it : A curved silver tube being passed beneath the artery, a probe, fitted to the tube, and previously armed with a ligature, is then pushed through it, and the ligature drawn along with it : It proves to be, however, a much more complex method of answering the same purpose with the needle, and will never

ver therefore be employed by those who have used the other.

The ligatures being both passed, the upper one is now to be tied sufficiently firm for compressing the sides of the artery. By some, a small bolster of linen is inserted between the artery and the knot, in order to prevent the artery from being cut. This, however, can answer no good purpose; for if the whole artery is not surrounded with the bolster, it will be just as liable to be cut by the ligature, as if this precaution had been omitted: And besides, as I have elsewhere had occasion to remark, the ligature on arteries need never be so tight, as to incur the risk of dividing them; much less pressure than is commonly applied being sufficient.

The upper ligature being thus finished, before the knot is passed upon the other below the orifice, the tourniquet should be untwisted, in order to see whether any blood is discharged by the wound in the artery or not. If blood flows freely, it will afford a pleasant prospect of the success

cess of the operation, as it will shew, that the anastomosing branches are sufficient for carrying on the circulation in the under part of the limb. But although blood should not be discharged at this time by the orifice, we are not, from this circumstance alone, to despair of success; for it frequently happens, that the operation succeeds, although no blood is discharged on the trial that I have advised.

But whether any blood should be discharged by this trial or not, we should not rest satisfied with one ligature; for unless the ligature below the orifice is also tied, hemorrhagies may probably take place on the return of circulation to the under part of the artery: This precaution, therefore, should never be omitted; it is easily done, and it renders the patient secure against all farther loss of blood. After the knots are tied, the ligatures should be cut of such a length as to admit of their ends lying over the wound, so that when necessary they may be more easily withdrawn.

With a view to farther security, it has been advised to insert other two ligatures quite contiguous to these, and to leave them untied, so that if either of the others should happen to fail, its place may be immediately supplied.

There is not, however, any cause for this precaution, for, if the first ligatures are properly applied, they will not fail to answer the purpose; and in the event of one or both of them giving way, they can be easily renewed: We also have it in our power to render the patient safe against any sudden discharge of blood, by leaving the tourniquet loose upon the upper part of the limb, which it ought always to be for several days after the operation, so that, in the event of blood bursting from the wound, it may at once be secured.

The ligatures being completed, the tourniquet should be made loose; and if no blood is discharged at the orifice in the artery, we may conclude that the operation is properly performed.

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The wound should now be lightly covered with a pledget of any emollient ointment ; and a compress of soft lint being applied over the dressings, the whole should be secured with two or three turns of a roller above, and as many below the centre of the wound.

The patient being now laid in bed, the limb should be placed in a relaxed posture upon a pillow, so as to create the least possible uneasiness from the posture in which it is placed.

As this operation is always tedious, and excites much pain and irritation, a full dose of laudanum should be given immediately after it is finished. With a view to diminish sensibility in surgical operations, I have in different instances given opiates about an hour before : With some, this has evidently proved useful, but with others it has appeared to do harm ; particularly in weak irritable constitutions, in which with any doses I ever ventured to give, the patients appeared to be rendered more susceptible of pain, than if no opiate

had been taken. Immediately after every operation of importance, however, an opiate should be given, and repeated occasionally, according to the degrees of pain and restlessness which take place.

In some few cases of aneurism, it happens, that the pulse in the under part of the limb is perceptible immediately after the operation. This, however, is not frequent; for aneurism being more commonly met with at the joint of the elbow, as a consequence of blood-letting, than in any other situation, and as it rarely happens that the brachial artery divides till it passes an inch or more below the joint, the trunk of this artery is therefore most frequently wounded; and, as the ligatures in this operation must obstruct the passage of almost the whole blood going to the under part of the arm, there can be no reason to expect any pulsation at the wrist, till the anastomosing branches of the artery have gradually become so much enlarged, as to transmit such a quantity of blood to the under part of the limb, as may be sufficient
for

for acting as a stimulus to the larger branches of the artery.

Immediately after the operation, the patient complains of numbness or want of feeling in the whole member; and as it commonly becomes cold, it ought to be kept properly covered. In ten or twelve hours from the operation, although the numbness may continue, the heat of the parts generally begins to return; and, in the course of a few hours more, all the under part of the limb is even apt to become preternaturally warm.

Although physiological discussions are not immediately connected with our subject, and although I shall not therefore enter on them often, yet I cannot here avoid to remark the clear proof which we derive from this operation, of the great dependence that one part of the human frame has upon another. The nerves we know to be the instruments of sense and motion; but on being deprived of their usual support from the sanguiferous system, their influence is instantly lessened.

Immediately after this operation, the want of feeling in the parts below the ligatures, is commonly great; and in proportion as the circulation takes place in the under part of the limb, the feeling never fails to return. If we could suppose the nerves of the parts below to be always included in the ligature with the artery, that numbness which succeeds to the operation might be easily explained; but I have known it happen when nothing but the artery was secured with the ligature: And besides, although the knot upon the nerves would account for the immediate loss of sensibility which succeeds to the operation, it would not serve to explain the return of feeling, on the circulation being restored; for the nerve being destroyed by the ligature, if the want of feeling originated entirely from this, in what manner could the return of blood to the part be supposed to act in restoring it?

In the mean time, the regimen and situation of the patients are points which require particular attention: He should be
allowed

allowed cordials and nourishing diet when low and reduced, and confined to a low diet, if his constitution is plethoric: The limb should be kept in a relaxed posture, and towards the end of the fourth or fifth day, if the operation is to succeed, a weak feeble pulse is discovered in the under part of the limb; and as this becomes stronger, the patient in the same proportion recovers the use and feeling of the parts.

As soon as matter has formed about the fore, which seldom happens till the fifth or sixth day, an emollient poultice should be applied over it, in order to soften the dressings, which should then be removed. At this time, too, the ligatures might be taken away; but as their continuance for a few days longer can do no harm, it is better to allow them to remain till the second or third dressing, when they either drop off of themselves, or may be taken away with more safety. The dressings, which should always be of the softest materials, being renewed every second or third day,

according to the quantity of matter, the fore for the most part heals easily ; and although the patient may for a considerable time complain of numbness, and want of strength in the diseased limb, yet in most instances a very free use of it is obtained at last.

It will be readily supposed, that this termination is the most favourable that can possibly happen. In some instances, our success is far from being so complete : Instead of a return of circulation, and of the feeling and use of the parts, they remain cold and insensible, and no marks of returning life are perceived. From a mere want of blood, therefore, mortification at last takes place ; and as nature is here deprived of one of her principal agents for the removal or separation of gangrenous parts, I mean the efforts of the sanguiferous system, the disease for the most part terminates fatally.

Whenever mortification, therefore, ensues, as a consequence of this operation, if
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the patient survives till a separation takes place between the healthy and diseased parts, amputation of the limb is then our only resource.

That this operation, when performed upon the principal artery of a limb, sometimes terminates in this manner, no practitioner will deny; but its doing so in some instances, does not warrant our rejecting it in all. The event of every capital operation is very uncertain; and in this, as in every other of equal importance, as we cannot in any case say with precision how it will succeed, so we are never to advise it where means of a less hazardous nature will answer: While, on the contrary, when these are found to fail, and the patient's life appears to be in danger, it ought without hesitation to be performed.

Among the numerous improvements which modern surgery has experienced, one of the most ingenious is a new method of operating for the cure of the popliteal aneurism,

aneurism, first proposed by the late Mr John Hunter of London.

In operating for this variety of aneurism in the usual way, the depth of the artery renders it both difficult and tedious; besides which, from the artery being frequently diseased for a considerable way above the seat of the aneurism, the operation is thereby apt to fail. With the view of avoiding these difficulties, the femoral artery is secured, in the new operation, about the middle of the thigh; by which, when the operation succeeds, the tumor in the ham soon disappears, and in the course of a few weeks, the patient recovers the use of his limb.

In performing the operation in this manner, the tourniquet should be applied as near as possible to the top of the thigh; but not drawn tight, in order to preserve the parts in their relative situations: An incision, four inches in length, is then made through the skin and cellular membrane, rather above the middle of the thigh,

thigh, and crossing the inner edge of the sartorius muscle in an oblique direction from above downwards. The sartorius being brought fully in view, the edge of it must be raised where the pulsation of the artery is perceived through the fascia by which it is covered. This is next to be divided to the extent of two inches, when the artery must be carefully separated from the nerve and vein with which it is accompanied; and a broad waxed ligature of silk being passed round it, by means of a blunt-edged hook, a firm knot must now be tied on it; and the ligature being left out at the edges of the wound, they should then be laid together, and the whole covered with a pledget of simple ointment.

On the patient being put to bed, a tourniquet should be applied loosely on the upper part of the thigh, with the view of putting a stop to any unexpected hemorrhagy, and the limb should be placed on pillows, raised to such a height, that the thigh and leg may form an angle with the
body,

body, as well as with each other ; in this manner, relaxing the muscles, and particularly the sartorius, as much as possible ; care being also taken, during the first eight or ten days, to retain the limb steadily in this situation.

On the fourth or fifth day, the dressings may be changed ; but the ligature should not be drawn till the fifteenth or sixteenth day, when in general it will come easily away. Till the end of the third week, the patient should be kept in bed ; nor should he be allowed to use his limb with freedom for the space of several months after the operation.

This is undoubtedly a very important improvement on the method of operating for the popliteal aneurism, but further experience of the effects of it alone can shew whether it will in general succeed or not ; and till this shall be obtained, we must remain uncertain, whether this operation, or that of amputating the limb at the upper part of the thigh, will fall to be preferred ;

red ; for it is not that mode of conducting a cure which carries the best appearance, that ought to meet with our preference, but that which experience proves to be the best, in consequence of its saving the greatest number of lives.

CHAP-

CHAPTER X.

Of Affections of the BRAIN from External Violence.

SECTION I.

General Remarks on Affections of the Brain from External Violence.

AFFECTIONS of the Brain from external violence, often induce a very complicated set of symptoms ; are attended with imminent danger, and give much embarrassment to practitioners : Accordingly,

ingly, both with respect to the hazard with which they are attended, and the difficulty that we meet with in the cure, there is perhaps no class of diseases to be compared with them. Wounds and bruises of the head, which at first exhibit no marks of danger, often induce a train of symptoms which elude the skill of the most experienced practitioner; and, without admitting of any mitigation, proceed to a fatal period, ending only with the death of the patient.

The very intricate nature of these affections has excited the attention of practitioners from the time of Hippocrates downwards; but although this branch of practice has received some important improvements, from the industry and observation of modern surgeons, yet it must be admitted, that much still remains to be done in it. Authors of the last and preceding centuries have proposed modes of treatment in affections of the head, which modern practitioners do not admit; whilst in various points of importance, surgeons
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of our own times differ materially from one another.

This uncertainty which prevails with respect to the nature and treatment of these affections, proceeds from different causes, the principal of which appear to be the following.

I. The necessity of a sound and entire state of the brain for the purposes of life and health, together with the peculiar delicacy of its structure, makes injuries which in other parts of the body would induce no danger, when inflicted on this organ productive of the most alarming consequences.

II. The brain being surrounded with a firm covering of bone, it is always difficult, and in many cases impossible, to obtain an exact knowledge of the nature of the case, and of the parts more immediately injured: Inasmuch, that while the attending symptoms often lead us to presume that the brain has suffered, if no external marks of injury appear, we are frequently at a loss to determine where
the

the instruments necessary for the relief of the patient should be applied: For this reason, we have not, perhaps in any instance, so much cause to regret our very limited acquaintance with diseases, as in affections of the brain; in which discoveries are often made upon dissection after death, a knowledge of which, if obtained a day or two sooner, might have put it in our power to save our patients.

III. The most material impediment to our successful treatment of diseases of this class, is the impossibility of obtaining an easy and free access to the injured parts, even when we know with certainty where they are seated. For, the brain being on all sides surrounded with bone, we can rarely accomplish so extensive an exposure of the injured parts as the proper treatment of them requires.

IV. The manner in which diseases of the head from external violence have been commonly described, has had some influence in rendering this part of practice perplexed and intricate. Till of

late years, authors have attended more to the consideration of the causes which induce diseases of the head, than to the real nature and treatment of the affections themselves: Occupied almost entirely in describing the one, they have very universally passed over the other too remissly*.

Thus, the various contusions and wounds to which the head is exposed, have been particularly described; and every variety of fracture which can happen has been mentioned with a minute accuracy. The most trifling differences that can occur, have been distinguished by particular appellations, and much ingenuity has been exercised in describing the extent with respect to length and breadth, and every other circumstance relative to the figure of a fracture; points of very little importance; and which, when so much in-

fisted

* The French authors upon this subject, were the first among the moderns who wrote upon it with precision. And among these, that judicious practitioner Monsieur Le Dran stands particularly eminent: I need scarcely observe too, that the public are much indebted to our countryman the late Mr Pott, for his valuable work upon this subject.

sisted upon, tend to perplex not only the younger, but even the more experienced, part of the profession. Nothing, indeed, can set the impropriety of such distinctions in a stronger point of view, than our observing daily that no advantage ever ensues from them. It is the effect which fractures of the skull and other injuries produce upon the brain, which we ought to consider, and not their external appearances.

If indeed the effects produced upon the brain by a fracture of the skull could be determined by the size and figure of the fracture, it ought to be minutely described; but every practitioner knows that this is not the case. Fractures of the smallest size will in some instances produce the most dangerous symptoms, whilst in others those of the greatest extent excite no alarming appearance. As long as it was imagined that the danger induced by fractures of the skull was in proportion to their extent and figure, we need not be surprised at the attention with which these

circumstances were considered ; but now, while we know that no advantage can be derived from distinctions of this kind, I shall not judge it necessary to dwell particularly upon them.

These are the circumstances which render the management of affections of the brain from external violence uncertain. In the subsequent part of this chapter I shall endeavour to point out the means best calculated to extricate this part of practice from such uncertainty ; but before proceeding to do so, it will not be considered as improper our giving a concise anatomical description of the parts most apt to suffer from injuries done to the head ; as by this the subject will be rendered more clear and intelligible.

SECTION II.

Anatomical Description of the Brain and surrounding Parts.

THE brain and cerebellum, with their membranes the dura and pia mater, have for their protection a covering of bone, the Cranium.

The cranium consists of eight bones, forming an oblong vault or box, flattened on the sides by the superior firmness of the lower part of the temporal bones, and by the constant action of the temporal muscles: It is more capacious on the back part than before, the lobes of the brain being here more extensive.

The bones of the cranium or skull, are, the frontal bone, the two parietal bones, the two temporal, the occipital, the sphenoid, and ethmoid. The first six of these are said to be proper to the skull, the two last being considered as common to it and

the face. The os frontis forms all the anterior or fore part of the cranium, the ossa parietalia the middle and upper part, and the os occipitis the posterior part of it: The ossa temporum form the lower part of the sides of the cranium; and the sphenoid and ethmoid bones form the centre, or what is commonly termed the basis of the skull; but as these two last-mentioned bones lie so deep, as to be entirely out of the reach of any surgical operation, any injury to which they may be exposed, must in almost every instance prove fatal.

The other six bones are connected together by joints or indentations, termed Sutures, which are five in number, the coronal, sagittal, lambdoid, and two squamous.—The coronal suture extends over the head, from within a short space of the external canthus of one eye, to within an equal distance of the other on the opposite side of the head; and in its course, it serves to unite the frontal bone to the anterior edge of the two parietal bones.—

The

The sagittal future unites the parietal bones on the superior part of the skull, by running almost in a direct line from the middle of the frontal bone to the middle of the os occipitis: In some instances this future proceeds along the whole extent of the os frontis, and terminates immediately above the nose, by which that bone is divided into two equal parts; and instances are mentioned of the occipital bone being divided in a similar manner; but this is confessedly a rare occurrence.

The lambdoid future, so called from its resemblance to the Greek letter Λ , begins, where the sagittal future terminates, at the middle of the superior edge of the occipital bone; and its two crura or legs stretching down to the basis of the skull, serve to unite this bone to the posterior edge of the two parietal and temporal bones. It is in the course of this future, namely, the lambdoid, that these small irregular ossifications, termed ossa triquetra, are most commonly met with. In

some instances they penetrate the whole thickness of the bone ; but in others, they are chiefly confined to the external lamella of the skull, being scarcely perceptible inwardly.

The last futures we have to notice, are the two squamous, which serve to unite the superior part of the temporal bones to the under and corresponding parts of the ossa parietalia.

In young people, these five futures are almost universally met with, and it is necessary that practitioners should be well acquainted with their direction ; but it is proper to observe, that in older subjects, some of them are often wanting. Instances are even recorded, in which all the futures were completely obliterated ; but this I believe to be a very rare occurrence. The sagittal and coronal futures, are those that are most frequently wanting.

Various advantages are derived from the formation of the skull by separate bones ; but that which we have particularly to mention, is, that at the futures, a
more

more direct communication, by means of bloodvessels, takes place between the membranes of the brain and the teguments of the skull, than otherwise could have been the case; and by means of these futures, too, there is reason to suppose, that fractures will not spread so extensively as if the whole cranium was formed of one bone only.

Some advantage is in this manner accordingly derived from the skull being formed of different bones; for in the early stages of life, while the bones are not firmly connected together, fractures do not so readily pass across the futures, as they afterwards do: But nature must surely have had some other intention in this mechanism, otherwise the more perfect adult would not probably be deprived of an advantage which the earliest period of childhood enjoys in greater perfection: and although I have said, that the futures have evidently some influence in young people, of stopping the progress of fractures, their effect is evidently not considerable; for
daily

daily observation evinces, that fractures pass from one bone of the skull to another, even while the sutures remain in every respect entire; a circumstance which every young practitioner especially should be aware of; for, from many observations to be met with in some of our older writers, we might be led to imagine, that fractures rarely if ever traverse the sutures, which however we frequently find them do.

The bones of the skull are, for the most part, composed of two lamellæ or tables, separated by a kind of bony net-work, or cancelli, commonly termed the Diploë. The external table is every where considerably thicker than the internal, which is firm, compact, and more brittle than the other; which readily accounts for what we sometimes meet with, a fracture and even a depression of the internal table of the skull, while the external surface of the bone remains entire: But it unfortunately happens, that the discovery of this is seldom or never made, till it is too late to prove useful; I mean not till after the death of the patient.

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In the directions given by authors for applying the trepan, we are commonly desired to proceed with much caution in passing the instrument through the inner table of the skull, while we are told that no danger can ensue from proceeding quickly. in the first part of the operation till the outer table and diploë are fairly penetrated. This however proceeds upon the supposition of the two tables of the skull, with the intermediate diploë, being at all times distinct and obviously marked. Now we know, that this is not the case; for the diploë becomes less with age, and in many instances it has been so completely obliterated as to take away entirely the appearance of two tables of the skull over all the upper part of the head: And besides, in some parts of the skull, the diploë is naturally wanting, particularly in different parts of the os occipitis, owing perhaps to the pressure produced upon this bone by the muscles with which it is covered. It is also wanting at the under part of the os frontis, where the two lamellæ of
this

this bone separate immediately above the eye-brows, in order to form the two cavities of the frontal sinuses ; whilst in general it is more distinctly observed over all the superior part of the frontal bone, and through the whole extent of the ossa parietalia, than in any other part of the skull.

The external surface of all the bones of the upper part of the cranium, is in general smooth and equal, and this is also the case with the internal surface of the same parts of these bones, excepting the temporal bones and some part of the ossa parietalia, in which several deep furrows are formed by the pulsation of the arteries of the dura mater. But although the upper part of the skull is commonly smooth, almost the whole under part of it is rugged and unequal. This inequality on the outside seems to be calculated for the better attachment of the different muscles which move the head ; and on the inside it serves the purpose of supporting the different

ferent parts of the brain and cerebellum.

Almost the whole of the occipital bone is very unequal both in its external and internal surfaces : this is likewise the case with all the inferior part of the temporal bones, and with the under part of the os frontis ; so that none of these situations are so proper for the application of the trepan, as the more smooth and equal parts of the skull.

The skull is externally covered with the common teguments of the body, the skin, and cellular substance ; with the frontal, occipital, and temporal muscles, and an aponeurotic expansion formed by a combination of the tendinous fibres of them all ; and more immediately by the pericranium, a very strong membrane, which adheres firmly to every part of it, but particularly at the sutures.

It has by many been supposed, that the cavity formed by the bones of the skull, is not naturally completely filled. This, however, is now known to be an opinion void of foundation ; for every part of this
cavity

cavity is occupied by the brain and cerebellum, with their investing membranes the dura and pia mater.

The dura mater, which is a strong inelastic membrane, adheres every where to the internal surface of the skull by an infinite number of small vascular filaments, as is evident by those innumerable points of blood which appear over the surface of this membrane, and through the whole internal surface of the skull, on the cranium and dura mater being forcibly separated from each other. This adhesion, however, of the dura mater to the cranium, is much more firm at the futures than in any other part, owing to the bloodvessels which pass out here being not only more numerous, but of greater magnitude than in the rest of the skull. In other parts of the head, any vessels which pass from the dura mater to the skull seem to be chiefly intended to supply the internal table, and the diploë, with blood; but at the futures an evident communication takes place, by means of bloodvessels, between

tween the external coverings of the skull and the membranes of the brain, a circumstance which practitioners should be aware of, as it not only serves to explain many of the phenomena attending injuries done to the head, but likewise points out the most probable means of guarding against them. By our knowledge of this part of the anatomy of the head, we learn, that the futures are not the most eligible parts for the application of the trepan; and, on the contrary, that this operation should never be performed in the course of a future, if the same intention can be answered by applying the instrument on any other part; and that, by the firm adhesion of the dura mater to the skull at the futures, matter or blood collected on the surface of that membrane on one side of a future, will not be discharged by a perforation made on the opposite side of it.

The dura mater, the firmness of which renders it particularly proper to support the brain by its different productions, is of too hard a texture to be immediately
connected

connected with that very delicate organ. It is therefore every where lined with another soft membranous expansion, the pia mater, which is immediately applied over the whole surface of the brain and its convolutions.

The great quantity of blood sent to the brain and its coverings, is supplied by the carotid and vertebral arteries, and is again returned by the jugular veins; but before reaching these veins, it is emptied into a number of sinuses or reservoirs, formed by productions or duplicatures of the dura mater: These sinuses all communicate with each other: They are numerous on the back-part of the head, but the most material for surgeons to be acquainted with, are, the longitudinal, which runs along the middle and upper part of the head, directly in the course of, and firmly attached to, the sagittal future; and the two great lateral sinuses, in which the longitudinal sinus terminates at the middle and upper part of the cerebellum, at which part these two sinuses commence,
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the one going to the right and the other to the left, and passing down to the basis of the skull, they there terminate in the jugular veins.

This general account of the anatomy of these parts, will serve to render the consideration of the injuries to which they are exposed more clear and intelligible; while a more minute description of them would not only be incompatible with the nature of this work, but would not in any respect be necessary; for the most minute description that can be given of the different parts of the brain would be of no advantage to practitioners in the treatment of those affections to which it is liable. We may, in general, observe upon this point, that the brain is an organ essentially necessary for life; and, that its parts cannot be deranged, either by wounds, contusions, or compression, but with the utmost hazard: For although we sometimes meet with instances of the brain being much injured, and even of parts of it being discharged at wounds, without

any important consequences taking place ; yet these are rare occurrences, and are by no means sufficient to invalidate this general observation, that a sound and entire state of this organ is highly necessary for the purposes of life.

I shall now proceed to treat more particularly of the nature of those injuries to which the parts that have just been described are liable ; but instead of enumerating in separate sections, as has commonly been done, the various causes of affections of the head, and the symptoms which each of these excite ; I mean to consider the general effects which they produce upon the brain, and to point out the manner in which they appear to operate, together with the means which from experience have been found to answer best in their removal.

All the symptoms of affections of the brain from external violence seem evidently to originate from one of the following circumstances ; namely, from compression of the brain ; from commotion or
concussion ;

concussion; or from inflammation. These I shall proceed to consider in separate sections; and as far as the intricate nature of the subject will admit, I shall treat of them as distinct and unconnected with each other: For although we are not to expect that the symptoms arising from these different causes, are always distinct and precisely marked, and without connection with each other; yet it frequently happens that they are so, and it is in their separate uncombined state only that any description can be given of them. Practitioners of experience must indeed know, that causes frequently occur, by which all the affections of the brain that I have mentioned are induced at the same time in the same patient; and in such instances, the symptoms which they produce are no doubt so very confused as to be with difficulty distinguished: Thus, a stroke upon the head, attended with symptoms of concussion, is frequently accompanied with those which proceed from compression; and these again are in some

instances succeeded by all the symptoms of inflammation.

The appearances induced by the various combinations of these, can be learned only from practice and observation; but an accurate knowledge of them as they occur in a separate and unconnected state, will prove highly useful in the cure, under whatever form they may occur.

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SECTION III.

Of Compression of the Brain from external Violence.

A GREAT variety of symptoms are enumerated by authors, as indicating a compressed state of the brain from external injuries; but the most frequent, as well as the most remarkable, are the following: Giddiness; dimness of sight; stupefaction; loss of voluntary motion; vomiting; an apoplectic stertor in the breathing; convulsive tremors in different muscles; a dilated state of the pupils, even when the eyes are exposed to a clear light; paralysis of different parts, especially of the side of the body opposite to the injured part of the head; involuntary evacuation of the urine and fæces; an oppressed, and in many cases an irre-

gular pulse; and when the violence done to the head has been considerable, it is commonly attended with a discharge of blood from the nose, eyes, and ears.

Some of the milder of these symptoms, such as vertigo, stupefaction, and a temporary loss of sensibility, are frequently induced by slight blows upon the head: And as they often appear to be more the consequence of a shock or concussion given to the brain, than of compression induced upon it; so they commonly soon disappear, either by the influence of rest alone, or of the other means to be hereafter pointed out. But when any of the other symptoms take place, such as convulsive tremors,—dilatation of the pupils,—involuntary passage of the urine and fæces,—and especially when much blood is discharged from the nose, eyes, or ears, we may always conclude with a good deal of certainty, that much violence has been done to the brain, and that compression in one part or another is induced upon it.

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In the anatomical description of the cranium and brain, I had occasion to remark, that the cavity of the skull in a state of health, is completely filled by the brain, no vacuity whatever being left between them : It therefore necessarily follows, that compression of the brain will be produced by whatever tends to lessen the cavity of the skull.

A diminution of the cavity of the skull may happen in various ways ; by fractures attended with depression of any part of the bones of which it is composed ; by the forcible introduction of any extraneous body through both tables of the bone ; and by the effusion of blood, serum, pus, or any other matter. The same effect may be likewise produced by the thickening of the bones of the head, as sometimes happens in lues venerea, and by water collected in the ventricles of the brain in cases of hydrocephalus internus.

These two last-mentioned causes, however, proceed from, and are connected with, diseases which it is not our business

in this place to consider. The effusion of pus or any other matter not evidently either blood or serum, must always be the consequence of inflammation, and will fall to be considered in a different section; and as the introduction of extraneous bodies into the brain must always be attended with a fracture, and commonly with depression of some part of the skull, the consideration of the one is necessarily connected with that of the other. I shall now therefore proceed to speak more particularly of fractures attended with depression, and shall afterwards consider the other general cause of compression of the brain, effusion of blood or serum.

§ I. *Of Compression of the Brain from Fractures attended with Depression of the Skull.*

FRACTURES of the skull, as I have already observed, have been distinguished by a variety of appellations according to their

their figure, extent, and other circumstances of little importance: To retain these distinctions, could therefore answer no good purpose; and as it might embarrass the younger part of the profession, I do not mean to mention them.

The only general distinction of fractures necessary for us to retain, is, those which are attended with depression, and those which are not. All the variety of the latter I mean to comprehend under the denomination of Fissures; but the consideration of these will be more properly introduced in a different section.

Fractures of the skull may be produced in various ways: By falls from a height; by blows with sharp or blunt instruments; and by missile weapons, such as stones, and balls thrown from a distance.

Authors, who have entered minutely into this part of the subject, observe, that in the treatment of fractures, much advantage may be derived, from a knowledge of these circumstances; and that we may even ascertain with some precision,

sion, the degree of violence that has been done to the brain, from being acquainted with the cause by which it was produced.

But although it is proper to inquire into the nature of the cause of every fracture, yet we are not to imagine that any material advantage will be derived from it: we know, indeed, that a fracture of the skull, produced by a blow with an obtuse or blunt instrument, or by a fall from a considerable height, is frequently attended with more alarming symptoms than a fracture of the same extent with a sharp instrument. This, however, is not universally the case; and as it is impossible to ascertain the extent of any injury done to the brain by this circumstance alone, little or no dependence should ever be placed on it.

In the management of fractures of the skull attended with depression, the indications are,

1. To discover as exactly as possible the site, the course, and the full extent of the fracture.

2. To

2. To obviate the effects of the injury done to the brain, by elevating or removing all the depressed parts of the bone.

3. To endeavour to complete the cure by the application of proper dressings, and attention to the after-treatment.

These are the objects which we ought to have in view. In many instances, indeed, this is put out of our power by the nature of the fracture ; but in others, when these indications can be accomplished, we are frequently able to afford more effectual relief to patients, than it is ever in our power to do in the treatment of any other malady.

In fractures of the skull, the teguments covering the injured part of it, are frequently cut, lacerated, or even altogether torn away. In this case, the state of the bone is at once rendered evident ; the fracture is immediately discovered, and the surgeon is left at liberty to employ the most proper means for obviating the effects of it : But when the skin and other teguments are entire, it often happens, even when,

when, from a concurrence of circumstances, we are tolerably certain of the existence of a fracture, that we do not easily ascertain it.

When any outward mark of injury takes place, particularly when a tumor is perceived on any part of the head, accompanied with appearances of a recent contusion, the symptoms are commonly found to originate from a fracture directly underneath ; and on the bone being laid bare, in the manner to be hereafter mentioned, the course of the fracture is in general discovered.

But every practitioner knows, that injuries done to the head frequently produce affections of the brain, and even fractures of the skull, without leaving either tumor or any other external mark by which they can be discovered. In this situation, the whole head should be shaved, when it will sometimes happen, that a particular spot will appear red, which could not be observed till the hair was removed, and will thus lead to a discovery of the injured part.

part. But when no tumor, inflammation, or any other mark is discovered, we may in some instances be directed to the seat of the injury, by pressing firmly over the whole head: and if we find, on repeated trials, that pressure excites more pain in a particular part than in others; of which we may be convinced if the patient moans much on pressure being applied to it, and if he puts up his hand or draws away his head; on this trial being repeated, we may conclude with much probability that this is the seat of the injury.

In circumstances, such as we are now considering, so fraught with danger to the patient, and so perplexing as they frequently are to practitioners, nothing that can throw light upon the nature of the case should be overlooked. If the patient raises his hand, and applies it frequently upon or near to the same part of the head, even this will merit attention; for in this manner I have in different instances been led to the site of a fracture.

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When therefore the symptoms of a compressed brain are evidently marked, we ought, without hesitation, to proceed to examine the state of the cranium wherever appearances give cause to suspect that a fracture has taken place. We do this by laying the bone bare by making an incision with a scalpel through all the external coverings of the skull.

In performing this operation, when the bone is previously found to be much injured, which in some instances is the case even where the skin directly above it is not lacerated, the incision through the integuments should be made with caution; otherwise the brain may be hurt, either by the knife pressing on some detached portion of bone, or even by the point of it passing in between two of the separated pieces. But when the bone upon which the incision is made, is not either broken into different portions, or when the edges of the fractured pieces have not receded from each other, and do not in any degree yield to pressure, the division of the skin
and

and other teguments may be then performed with freedom, by cutting through the whole of them down to the bone, with one stroke of the scalpel.

The sole intention of this operation is to bring the injured parts of the bone into view ; but although the means of effecting this should be simple and easy, a very painful and severe method of doing it has been commonly practised.—It has been in general supposed, that in fractures of the skull, the injured parts cannot be sufficiently exposed, either for the purpose of tracing the course of the fracture, or for applying the trepan, unless a portion of the skin and other teguments is altogether removed : With this view, some have advised a crucial incision to be first made, and the corners to be cut off. Others recommend an incision of the form of the letter T : while by many we are advised to remove a circular or oval piece of the teguments at once.

Various objections, however, occur to all of these.—They not only produce a
painful

painful wound, which is commonly difficult to heal; but by exposing a considerable part of the skull, tedious exfoliations sometimes take place, which might be prevented; and the covering which nature afterwards provides for the denuded bone never answers the purpose so well as the teguments that were removed. Even all of these objections, however, to the practice that we are now considering, should be considered as trifling, and ought not to be regarded, if we could not by more simple means discover the extent of fractures, and if we could not likewise by the same means apply the trepan, or any other remedy. But as both of these objects can perhaps in every instance be accomplished in a more easy manner, the other ought to be laid aside.

On a simple incision being made in the manner I have directed, the teguments always retract so much as to admit of the bone being freely examined; and if a fracture is discovered, the course of it may be always traced with as much certainty

tainty by extending this incision along that part of the bone in which the fracture is found to run, as if a considerable portion of the teguments was removed: And this retraction of the divided parts also admits of the application of the trepan.

On the teguments being in this manner divided, if the skull is found to be fractured and depressed, the nature of the case at once becomes obvious; and the means to be hereafter pointed out for the treatment of fractures attended with depression, should be immediately employed. But even where no outward appearance of a fracture is met with, and where no tumor, discoloration, or other external mark of injury is discovered, if the patient continues to labour under symptoms of a compressed brain; if the pericranium has been separated from the bone; and especially if this membrane has lost its natural appearance, and has acquired a pale white or dusky yellow hue; the trepan should be applied without hesitation at

the place where these appearances mark the existence of an injury, for, in this manner alone, blood or serum, which may have been effused, and by which the compression is induced, can be removed: It would, therefore, in such circumstances, be highly improper to trust to the absorption of the extravasated fluids, as by some has been advised; the chance of a cure from this being very doubtful.

Again, although no mark either of fracture, or any other injury underneath, should appear on the external table of the bone, still it is possible that the internal table may be both fractured and depressed. This is not indeed a frequent occurrence, but yet various instances of it are upon record: I have met with it in different cases; and other practitioners, on whose accounts we may place the most perfect confidence, likewise mention it.

I formerly observed that the internal table of the skull is thinner and more brittle than the external: how far this will explain the fact we have just been speaking

speaking of, I will not pretend to say ; but this is certain, that the injury done to the brain by the depression of the internal table of the skull, may be as great, and may prove as certainly dangerous, as if the whole thickness of the bone had been forced in. This is therefore another motive for the application of the trepan in all cases, accompanied with symptoms of compressed brain, even where no external mark of depression is discovered.

It will often indeed happen, that no relief will be obtained from the application of the trepan, even where the symptoms are such as proceed from a compressed state of the brain, induced either by a depressed portion of bone, or by extravasation of blood or serum. This want of success from the operation, may proceed from a concurrence of causes that we shall afterwards have occasion to mention : but the most fatal of all of them, is that which we term a contra-fissure, and the French a contre-coup ;—in which the skull is fractured and sometimes depressed, and blood

or serum perhaps effused on the surface of the brain, at a part very distant from that which received the blow, and where alone there is any apparent or external mark of mischief.

Many have doubted the reality of such an occurrence; for, as we cannot clearly account for it, so it is alleged, that it has rarely, or perhaps never happened.—As it is not the intention of this work, to enter upon minute theoretical discussions, I shall not attempt to explain the manner in which contra-fissures of the cranium may be produced: I shall just shortly observe, that doubts concerning their existence, can have been entertained by speculative writers only; for every practitioner of experience must have met with opportunities to ascertain the reality of the fact.

I will not pretend to say, that a blow received on one side of the head, will necessarily and certainly produce a fracture or other mark of injury on the opposite side; neither does it appear that the part
exactly

exactly opposite to the place where the blow has been received, will suffer more readily than other parts of the head, at the distance of only two or three inches. All I wish to establish is, that the skull may be fractured in parts not immediately contiguous to those upon which blows are given; and that this sometimes happens where no external mark can be discovered upon the teguments corresponding to the fracture, and while the bone remains perhaps entire on the part which more immediately received the injury.

We shall therefore consider it as matter of fact, that the skull may be fractured in parts at some distance from those which have more directly received an injury; and some advantage I think may be derived from this being kept in view.—In common practice, if no benefit is reaped from the application of the trepan; if no fracture is discovered of the internal table of the skull, or no extravasation on that part of the brain newly denuded by a removal of a piece of the bone; and if blood-let-

ting, laxatives, and the other means usually employed, do not remove the symptoms of compression; practitioners very generally conclude, that they depend either on concussion of the brain, or on extravasation in some of the internal parts of it, where the effects of an operation cannot reach; and accordingly, the patient is left to his fate, without any attempt being made for his relief.

In this, however, I think we are liable to much just censure and blame: For although a patient in such circumstances is undoubtedly in great danger, and although the chance of his recovering by any means we can employ, is inconsiderable, yet still he should receive this chance: In such circumstances, no attempt that we can make will add to his hazard, so that nothing should be omitted from which there is the most distant chance of relief being derived.

The head should be again examined with attention; and by pressing firmly, slowly, and deliberately, over every part
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of it, if even the smallest degree of sensibility remains, the patient will complain, either by moan, or signs with his hands, when pressure is applied to any part that is fractured. I have seen different instances of fractures being discovered in this manner, which, in the ordinary way of searching for them, had been altogether overlooked.

In whatever part of the head the patient complains on pressure being applied to it, the skull should be laid bare by an incision, in the manner I have mentioned. —If both tables of the skull are fractured and depressed, the cause of the mischief will thus be discovered: But even although no such depression or fracture should appear in the external lamella of the bone; as there is at least some chance of mischief being met with underneath, either from a fracture of the internal table, or from extravasation, and as nothing can possibly save the patient but the removal of this, the trepan should be immediately applied; and wherever there is

the least cause to suspect, either from pain being induced by pressure applied in the manner I have advised, or from any other circumstance, that mischief may be concealed, as long as relief is not obtained from what has previously been done, the operation should still be repeated, as the only means from whence any benefit can be derived.

This, however, leads to a point that merits more extensive discussion ; I mean, the effects produced upon the brain by the removal of a portion of the skull with the trepan.

By many of our older writers on this subject, it is said, that much hazard is at all times to be dreaded from this operation ; and in support of their opinion, they not only adduce a variety of facts, but employ much ingenious reasoning on the probable influence of the air finding access to the surface of the brain, an organ which nature has taken particular pains to protect from it.

Practitioners

Practitioners of modern times, however, have adopted a very different opinion upon this point: They even assert, that no danger can ever accrue from the operation of the trepan considered abstractedly; that it never proves hazardous of itself; and that it only apparently proves so from being often employed for the removal of symptoms for which this as well as every other remedy is altogether inadequate. In consequence of this, the trepan, in all injuries done to the head, is applied with freedom; in most instances, probably with much propriety; but in others, I am convinced, with very dangerous consequences.

My opinion on this important point is, that we should endeavour to avoid both extremes. For, although I clearly think, that the trepan should be applied with freedom wherever it is indicated by symptoms of a compressed brain, and where these symptoms must probably end in death, if the cause which produced them is not soon removed; yet I am equally satisfied,

tified, that it is the presence of such symptoms only which can warrant this operation ; and that it should never be employed, as it too frequently has been, merely with a view to prevent them.

In the one case, no additional risk can be incurred by the trepan ; and as the patient will in all probability suffer if it is not employed, we should not hesitate to advise it : But, as I am perfectly convinced, from attentive observation of the effects of this operation upon the brain, that it is by no means an innocent remedy, and, on the contrary, indeed, that it is frequently the cause of dangerous symptoms, which otherwise would not have appeared, I would never think of advising it but for the removal of symptoms already induced ; that are evidently of a dangerous tendency ; and that cannot be obviated in any other manner.

In a subsequent part of this chapter, when treating of fissures, I shall again enter on the consideration of this subject. In the mean time, before describing the operation

operation of the trepan, I thought it proper, in this manner, to mention the opinion I had formed of it.

Having thus considered the first general indication to be kept in view in the treatment of fractures attended with depression of the skull, we now proceed to the consideration of the second, which comprehends the means best adapted for the removal or elevation of a depressed portion of bone. We have already had occasion to see, that there is some variety in fractures attended with depression; and the means employed for removing them, are likewise various.

It often happens, that the corresponding teguments are either altogether removed by the cause which produced the fracture, or so much lacerated as to admit of the bone being freely examined; but when they are either not divided in any part, or not in a sufficient degree, the first object of the surgeon, as I have already observed, should be, to get the head shaved, and then to divide the skin and other teguments

teguments with a scalpel through their whole extent, and directly upon the course of the injury. If a fracture is discovered, and is found to proceed in a straight line, the incision should have the same direction: Or if it takes an angular course, the incision should likewise do so; for the sole object of the one is to bring the other as completely as possible into view.

In making this incision, one or more arteries are apt to be cut, and they sometimes continue for several hours to discharge freely; these, we are commonly directed, before proceeding further, to secure with ligatures.

If the patient is weak, or if a sufficient quantity of blood has been already discharged, this ought no doubt to be done: But as the membranes of the brain are commonly much injured by the depressed bone, and as nothing in such circumstances tends with such certainty to prevent inflammation, as a plentiful discharge of blood from the contiguous part; the arteries which have been cut by the incision

sion should be always allowed to bleed in proportion to the strength of the patient, when they will commonly retract, and give no further trouble.

The hemorrhagy from the larger arteries being stopt, the remaining steps of the operation are commonly postponed till the following day, in order to have all the oozing from the smaller vessels removed also : But as soon as the discharge from the principal arteries is over, that which takes place from the rest of the wound should not be regarded ; and as it may always be easily stopped, by the edges of the cut being covered with dry lint, and moderately compressed by an assistant, and as the pressure on the brain should always be removed as quickly as possible, the operation ought therefore to be quickly completed.

The extent of the fracture being ascertained as far as it can be done, and the blood from the incision stopped, we are next to endeavour to elevate the depressed portion of bone : the propriety of this, indeed, is sufficiently evident, and it has
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been admitted by practitioners of every age, although they have differed much in the mode of effecting it.

Surgeons of the last and preceding centuries were in general timid in every operation of importance, especially in such as were performed upon the head: And being commonly averse, as I have already remarked, to expose any considerable part of the brain, they endeavoured to elevate depressions of the cranium, either without penetrating the bone at all, or by means of very small perforations only.

For the purpose of perforating the skull, a kind of circular saw, commonly termed a Trepan, and of which I shall give a delineation, was always employed; but the opening formed by it was so small, that it was necessary to apply it often, even in ordinary cases, to accomplish the views of the operator: Many inconveniences ensued from this; to remedy which, various improvements upon this instrument were suggested, and figure 1. Plate VIII. represents the result of all of them. Thus improved,

improved, it removes a much larger portion of bone at once; and being entirely cylindrical, it penetrates the skull more easily than a conical saw, which, till of late was the only form in use.

In one circumstance, however, modern surgeons have not made any improvement of this instrument: They have rather indeed hurt it materially, by forming it so as to render the operation of perforating the skull with it both more difficult and more tedious than it otherwise might be. The instrument delineated in Plate VIII. cuts the bone not only more quickly, but with equal safety. The timidity of some operators, however, has made them imagine, that it cannot be used of this form, but with the hazard of passing too suddenly through the bone at the end of the operation, by which the brain would be unavoidably injured: They have accordingly invented another, which divides the bone very slowly, and which they therefore suppose will perform the operation with more safety. This instrument is termed a *Trephine*, and
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is delineated in Plate IX. fig. 1. This, however, is not possessed of any advantage over the other, not even that of being more safe for perforating the bone; for, the same degree of force must be applied by the operator with each of them; and it has this very material defect, that it requires more than double the time to perform the same operation that is necessary with the trepan. It has long, however, been almost the only instrument employed for this purpose in many parts of Europe, especially in Britain; so that prejudice may probably continue it in use: but whoever will attend to the principles on which the trepan and it are formed, will soon see that the former should be preferred.

When it was necessary to perforate the skull, the trepan, in its then unimproved state, was formerly the instrument chiefly employed. Others indeed were used for the purpose of forming openings in the bones; but they were so extremely rude and unmanageable, that it is not necessary

cessary to describe them; and this especially as delineations of all of them may be seen in the writings of almost every surgical author of the last and preceding centuries *. But, in many fractures and depressions of the skull, it was formerly imagined that the trepan was unnecessary, as it was then generally believed that the depressed parts of it might be raised by more simple means: With this view, some writers proposed to pass a screw in a slow and gradual manner nearly through both tables of the depressed bone, and then to raise it into the place that it formerly occupied, by pulling the screw slowly and firmly upwards: And again in children, in whom the bones are more soft as well as more yielding, and in whom fissures are supposed to occur frequently without fractures, we were advised to cover all the teguments corresponding to the depressed portion of bone, with leather spread with adhesive plaster, and then by means of

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strings

* *Vide* the works of Hildanus, Scultetus, and Dionis.

strings or cords fixed to the back part of the leather to elevate the depression.

Whether a depression ever occurs, however, even in early periods of life, without a corresponding fracture of at least one of the tables of the skull, is much to be doubted. I rather think that it does not, at least I never met with it: and I have seen different instances which previously were supposed to be such, but which, after death, were all except one found to be attended with complete fractures; and in this the osseous fibres of the internal table of the bone were cracked or ruptured, while those of the outer table remained nearly entire. But whether this kind of depression ever occurs, or not, is not material: The means to be presently pointed out for elevating depressions of the skull will prove equally useful, whether they are accompanied with fractures or not; while I may freely venture to say, that no dependence should in either case be placed on adhesive plasters, as they are evidently inadequate to the effect.

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The powers of a screw in raising depressed portions of the skull would often be sufficient, but as it could neither remove any sharp points of bone which might be beat in upon the brain, nor serve to discharge any diffused blood which frequently accompanies fractures attended with depression, this means of removing depressed portions of bone will never probably be adopted. It has commonly, too, been objected to this instrument, that it cannot be introduced but with the hazard of forcing the depressed piece of bone upon which it is applied farther in upon the brain; and therefore that much mischief may thus be induced by it.—In many instances, however, the screw might be employed without hurting the brain; for the force necessary to pass forward a screw is inconsiderable; so that unless where a portion of bone is entirely detached from the rest of the cranium, a screw might frequently be inserted into the depressed piece with little or no hazard of forcing it in upon the brain.

—If therefore the other objections that I have adduced to it were not material, the latter would not be of much importance. And as some practitioners may incline to have it in their power in particular instances to use it, I have thus thought it right to give an account of it.

I shall now proceed to describe the practice of modern surgeons in fractures attended with depression of the skull, together with such improvements as the practice may appear to admit of.

The fractured part of the bone being brought into view by the division of the teguments in the manner I have advised, and the flow of blood being likewise stopped, the exact situation of the depressed part of the bone next requires attention. In some cases we find it entirely separated from the rest of the skull: In others, it adheres at one or two points: Whilst in some, a fissure or rent is discovered, with one side of the bone beat down below the plane or level of the other.

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When a portion of the skull is broken into several pieces, as they would never probably unite, either with one another, or with the surrounding bones, we are in general desir'd to remove them: But when only one piece of bone is depressed, and especially if this adheres at a point or two to the contiguous bones, practitioners often attempt to replace it, in order, as they say, to avoid that exposure of the brain which the removal of a large portion of the skull must always occasion; and they allege as a reason for this, that in some instances it succeeds, by the fractured and depressed piece uniting firmly with the contiguous bone.

It is not, however the unexpected success attending the particular treatment of a few cases by which we are to act: It is the result of general observation only by which our practice should be determined. Whatever may have happened with a few, in their attempts to preserve detached portions of the skull, practitioners of observation will allow, that more

advantage is in general to be derived from removing them at once.

It universally happens, when one or more pieces of the skull are either entirely or nearly separated from the rest, that blood in a greater or smaller quantity is effused upon the surface of the brain, or on the dura mater, through the whole extent of the injury ; so that, when a loose portion of bone is allowed to remain, neither this extravasated blood, nor the matter which afterwards forms, can find a free vent ; while the piece that has thus been detached and replaced seldom or never unites to the surrounding bone : By the early removal of the detached portions of bone, every inconvenience arising from this is prevented ; a free vent is thus given to any blood that may be presently effused, or to the matter which may form in future ; the state of the dura mater, and even of the brain itself, may be freely examined ; while inflammation and gangrene also, to which these parts are liable from fractures of the skull, are
thus

thus more effectually guarded against than they could be by any other means.

When the depression is formed by different small portions of bone, the whole of them may for the most part be easily taken out with common forceps; and by removing those portions first, that appear to be most detached, the rest will thus be loosened, and therefore more easily taken away. But it sometimes happens, even when several portions of bone are beat in, and very commonly when the depression is formed either of one piece entirely separated, or of a portion of the skull forced in upon the brain without any of it being altogether detached, that the depressed pieces cannot be either removed, or even raised into a level with the rest of the skull, in any other manner than by making one or more perforations in the contiguous sound bone, for the purpose of introducing an instrument termed a Levator, with a view to elevate the depression.

It is for this purpose chiefly that the trepan is employed: Hence it is evident, that this operation can never be necessary, when the depressed pieces of bone can be removed in the manner I have mentioned; for the sole intention of it is thus accomplished in a more simple manner. But when the depressed portions of bone are so firmly attached to each other, that they cannot be elevated but with the risk of wounding the brain or its membranes, which in fractures of the skull is very commonly the case, the trepan should without hesitation be employed, and the following is the method of doing it.

In books of surgery, those parts of the skull are commonly pointed out on which this operation may with safety be performed; and much pains has been taken to ascertain those that we ought to avoid. In practice, however, these limitations are seldom in our power to adopt, as the operation must always be performed near to the depressed portion of bone. But, as it appears from the anatomical description
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that I have given of the different parts that may be concerned in this operation, that it may not only be performed with more safety in some parts than in others, but with more prospect of advantage, practitioners should be so far directed by this, as to avoid, as far can be done consistently with the advantage of the patient, all those parts from whence much risk might ensue from a perforation being made in them. The parts which with this view we should avoid, are, almost all the under part of the temporal and parietal bones; all the under part of the occipital bone; the inferior part of the frontal bone; and the whole course of the longitudinal sinus. —The internal surface of the greater part of the two first of these bones are furrowed with the large arteries of the dura mater; a considerable part of the occipital bone is not only very unequal, but various sinuses lie immediately under it; the frontal sinuses lie in the inferior part of the frontal bone; and although we know that wounds of the longitudinal sinus do not
always

always prove fatal, yet as it transmits a large quantity of blood, we should at all times endeavour to avoid it : But when the depressed pieces of bone are so situated as to render it impossible to raise them without applying the trepan over these parts, as the patient would in all probability die if the depression was not removed, the trepan should be employed without delay. We are not wantonly and unnecessarily to perforate the skull where parts are situated which it might prove hazardous to wound ; but when the life of a patient depends upon this operation, no practitioner, it is hoped, will ever decline it, when it is possible to perform it.

Of all the situations I have mentioned, the most inconvenient for the application of the trepan, is, the back part of the head upon the occipital bone, and the frontal sinuses immediately above the orbits. Beneath the former, several large sinuses are dispersed, and both the external and internal surfaces of this bone are very unequal. And, again, the two lamellæ

mellæ of the frontal bone are separated so far from each other by the frontal sinuses, and the internal surface of the bone at this part is so very unequal, that no practitioner would make choice of it for the application of the trepan. But cases sometimes occur, in which it is necessary to apply the trepan in both of these situations. Wherever a fracture or any other cause of compressed brain is so situated that relief cannot be otherwise obtained, and where the patient must otherwise die, no difficulty should deter us.—The muscles of the occiput may be dissected off from the part where the trepan should be applied; and with care and attention, a perforation may be made even through the frontal sinuses.

The instruments in common use for this operation are the following: A Rasp-atory for removing the periosteum, represented in Plate VIII. fig. 3. A Perforator, Plate X. fig. 5. The Trephine itself, Plate IX. fig. 1. An instrument termed a Lenticular, Plate VIII. fig. 2. Forceps,

Forceps, Plate IX. fig. 2. and an Elevator, represented in Plate XI. figures 1, 2, 3, and 4.

In proceeding to the operation, the patient should be laid upon a table of a convenient height, with his head firmly secured by assistants : This being done, it is the common practice to lay a considerable part of the skull entirely bare round the part intended to be perforated. But this ought by no means to be done ; for although it is necessary to remove as much of the pericranium as may admit of the head of the instrument being applied as frequently as it can be needed, yet more should never be removed : tedious exfoliations of the denuded bone are apt to ensue from it ; by which the cure is not only retarded, but much more hazard induced.

We are, therefore, either with a scalpel, or the raspatory, Plate VIII. fig. 3. to separate and remove just as much of the pericranium as will admit of the trepan being
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ing freely applied, and no more ; and the part at which this should be done, ought to be exactly at that point where the greatest resistance seems to be to the elevation of the depressed piece of bone. With the view also of deriving every advantage from the perforation, it ought to be so formed as to include not only the fracture or fissure, but if possible a small portion of the depressed piece. The weight and pressure of the instrument during the operation, ought no doubt to rest chiefly on the sound undepressed bone, as much injury might be done to the brain, by making it press much upon the depressed portion of bone : but it very commonly happens, that a small segment of the opening may be made with perfect safety upon the depressed bone ; and as the advantages that result from this in the subsequent steps of the operation, are considerable, it ought in every instance to be done.

The pericranium being removed, a small hole should be made in the undepressed bone, with the perforator, Plate X. fig. 5.
care

care being taken, as I have already observed, to have it so near to the fracture, that the head of the trepan may include a portion of the depressed piece. As soon as the hole is sufficiently large for receiving the point of the pin in the centre of the circular saw, it ought to be inserted into it, by which the saw is firmly preserved in one place, till several turns being made with it, an impression of a sufficient depth is formed in the bone for retaining it, when the pin should be removed: for by projecting past the edge of the saw, it might injure the membranes of the brain before the perforation is finished; and as the sole purpose of the pin is to fix the instrument during the first part of the operation, it becomes unnecessary as soon as a cut is formed in the bone sufficient for retaining it.

The surgeon should now proceed to finish the perforation by pressing on the instrument with moderate and equal firmness; for if more pressure is applied to one side than another, the division of the bone will

will be completed at unequal periods, which ought to be carefully guarded against. If the trephine is employed, all the force necessary for turning it is applied by one hand of the operator; the saw is made to cut by forming only a half circle or scarcely so much; and the perforation is finished by moving the saw backward and forward, till the whole thickness of the bone is divided: But in using the trepan, the surgeon applies the pressure upon the head of the instrument with one hand, while he turns the handle with the other. Some operators indeed make the pressure with their forehead or chin; but it is both more easily and more equally applied with one hand. With the trepan the saw is made to move always in the same direction, by which it cuts more easily, and performs the operation in a third part of the time required with the trephine. When one perforation is sufficient, this is not indeed an object of much importance; but as several perforations are not unfrequently necessary, and as the operation

operation becomes thereby tedious, both to the operator and patient, that method of operating ought certainly to be preferred, which renders the means of cure more easy, provided it is equally safe. Now, it is obvious that the trepan is wrought with more ease than the trephine; and whoever has seen the operation done with both instruments, will confess that it likewise does it with equal safety: For in the hands of those accustomed to use it, there is no more risk of wounding the brain, by passing too suddenly in upon it with this instrument, than with the trephine. If the surgeon is cautious, there is no hazard of this with either of them; while, if not sufficiently attentive, the trephine will produce as much mischief as the other. Besides, in using the trephine, the head of the patient is apt to be much jolted by the unequal motion of the instrument, by which much uneasiness is produced in the mean time, while it also serves to promote that tendency to inflammation in the membranes of the brain,
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that is apt in every instance to occur from a portion of the skull being forced in upon them.

Some practitioners, very sensible of these advantages of the trepan, but dreading the risk of its passing too suddenly in upon the brain, commence the operation with this instrument, and finish it with the trephine*: This is far preferable to the usual method of performing the operation entirely with the trephine; but those who have fully experienced the advantages of the trepan, will employ it for the whole operation.

But whichever of these instruments are employed, the operator should proceed with great steadiness, and with as equal a degree of pressure as possible till the perforation is finished. For this purpose, the instrument should be frequently taken out, and the depth of the cut examined by in-

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* This, I believe, was first suggested by our present celebrated Professor of Anatomy, Dr Monro, to whose ingenuity surgery, in many points of importance, is much indebted.

roducing the point of a probe or sharp-pointed quill in the form of a tooth-pick : If the perforation has to go deeper in one part than in others, care should be taken to alter the pressure so as to carry on the cut of an equal depth to the last.

At each removal of the instrument, while the surgeon endeavours to discover the depth of the cut, and to clear it of blood and particles of bone, an assistant should have the charge of cleansing the saw with a small brush ; or, there may be two instruments with the saws exactly of the same size, so that while one is employed by the surgeon, an assistant may be cleaning the other.

When the instrument has reached the diploë, attention to the frequent cleansing of the saw becomes more especially necessary, as the blood discharged from this part of the bone, and from the spongy cancelli of which it is made, if not often removed, tends considerably to obstruct the operation : But we should not expect always to meet with the diploë ; for it is
wanting

wanting in some parts of the skull, and becomes less in every instance by age. The general direction, therefore, given for performing the first part of this operation freely and speedily till the diploë appears, cannot with safety be admitted: Every step of it should be done, as I have said, with steadiness; but with such caution, as to prevent every chance of the brain or its membranes being injured by the instrument being pushed forcibly in upon them.

But if caution is necessary in the first part of the operation, it afterwards becomes much more so: So that in proportion to the progress of the saw, it should be more frequently removed; and as soon as the point of a probe, or sharp quill, can pass entirely through at any part of the cut, the pressure should be removed from this point, and equally applied over the remaining uncut part of the bone. By proceeding in this cautious manner, the bone soon becomes loose in different points; and on this being discovered, it

may either be taken out with the forceps represented in Plate IX. fig. 1. or the points of two levators being insinuated into the bottom of the cut formed by the saw, one on each side of the piece to be removed, it may in this manner be easily and safely taken away.

I here think it necessary to remark, that practitioners are apt to be too anxious about the total separation of the piece of bone with the saw, before any attempt is made to remove it, from a fear of injuring the dura mater, if any splinter is left: That this may be avoided, they proceed with the saw till the bone is entirely separated; and in order to bring it out with the last application of the instrument, the head of the saw, till lately, has always been of a conical form, by which the piece of bone is very commonly taken out along with it.

But, however plausible these reasons may appear, the practice ought not to be adopted; for it rarely or never happens, that the piece of bone taken out by the
trepan

trepan is of an equal thickness in every part ; so that if the saw is made to divide one side of it long after the other is cut, the dura mater immediately under the part that was first divided would be hurt by the teeth of the instrument, notwithstanding all the caution that could be employed : Of this I have seen such a number of instances, even in the hands of expert surgeons, that I have no hesitation in advising the practice to be avoided. In various cases, indeed, where the operation has been supposed to be very properly performed, the mark of the saw has, after death, been evidently discovered on the dura mater over the whole circle of the perforation. Instead of proceeding with the saw, therefore, till the piece of bone is entirely separated, it is always safer to force it out in the manner I have mentioned as soon as it is discovered to be loose at different points ; and even where some small fragments or splinters of bone are left, no disadvantage ensues, as they are

easily removed with the common forceps, without hurting the dura mater *.

In addition to what I have said of the form of the saw, I may remark, that the cylindrical shape is in every respect preferable to the conical, which in some parts of Europe is still retained. I have already observed, that it is not by the form of the instrument that the dura mater and brain are to be avoided, but by proceeding through every step of the operation with due caution; and while the conical saw is not necessary for removing

* As the practice of taking out the circular piece of the skull entirely with the trepan, always appeared to me to be hazardous, I decidedly said so in the first editions of this work. The same remark has probably occurred to others, and Dr Monroe, I find, has long taken notice of it in his class.

With a view to prevent the brain from being injured, after the trepan has passed through one part of the skull, while the operator is employed in cutting the rest, it has been proposed by Dr Douglas, a physician of eminence in Kelfo, to have one of the heads of the trepan exactly the size of the others, but with teeth only on one side, by which the operation may be finished with more safety than in the manner in which it is usually done.

moving the piece of bone newly divided, it does not penetrate the bone with the same ease as a cylindrical saw, neither is the piece which it takes out so large, unless the size of the instrument is much larger than any that has yet been employed.

This circumstance, of the size of the opening made by the trepan, is an object of much importance, and therefore merits particular attention. For, as the intention of perforating the skull, is to relieve the brain from a state of compression, produced either by depression of the skull, or extravasation of blood or some other fluid; as this is much more effectually done by a large than a small opening; and as the pain and hazard of the operation are the same in both, a large opening should always be preferred. The perforation made by the trepan should never in an adult be less than an inch in diameter.

The piece of bone being removed, if any splinters or points are found to remain,

main, they may be taken out with forceps, or with the lenticular, but the latter is seldom necessary : This being done, we proceed to the main object of the operation, and endeavour to raise the depressed portion of bone.

If the elevation of the depressed bone has been prevented, merely by being firmly wedged at one point ; and if the trepan has been made to include this point, as it ought always to do, the whole piece, as it is thus entirely or nearly separated from the rest of the skull, may be now easily removed with the forceps ; or if it still adheres firmly at other parts, the trepan must be again applied at each of these before any attempt is made to remove it. But when the depressed portion of bone is not so much separated from the rest as to admit of being easily taken out, our next object is to raise it into a level with the rest of the skull.—With this view, the point of a levator should be introduced at the opening newly made, and being pushed in below the edge of the depressed bone,

bone, if it be not firmly wedged in, it may be easily raised by moderate pressure on the other end of the levator. But when the depressed piece is either of considerable extent, or gives much resistance at one or more points, before any attempt is made with the levator, the trepan should be applied again wherever it may appear to be necessary; and by a proper use of the levator at these different openings, it will then be easily raised.

The levator in common use, is not the instrument that I wish to recommend: For being made to rest on the opposite side of the perforation, all the pressure employed for elevating the depression falls on the contiguous parts of the skull, by which much violence is often done to it; and as the same intention may be accomplished in an easier manner, the other should be avoided.—By fixing the levator on a pin, supported by a small frame upon two feet, and this frame being placed at a proper distance from the wound, the pressure which it makes, falls on a sound
part

part of the skull, by which no harm can be done by it, while, from its simplicity of construction, it is easily applied, and readily moved from one part of the head to another. The instrument to which I allude is nearly the same with the levator of the celebrated Mr Petit of Paris, and it is represented in Plate XI. fig. 2.

As the great object of this operation is to remove the depressed portion of skull, together with every other cause of compression that is met with, I have taken different opportunities of pointing out the necessity of this being kept always in view. For if any portion of bone is overlooked, and should be allowed to continue to press upon the brain, little or no benefit would ensue from the rest of the operation; the patient would continue in nearly the same degree of hazard; and after death, the operator would be highly mortified to find, that with further attention, the life of his patient might probably have been saved.

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At the same time that care is thus taken to elevate the depressed pieces of bone, the removal of any blood or serum from the surface of the dura mater, is equally necessary ; and if any sharp-pointed instrument, pieces of stone, or other extraneous bodies, have been any where forced in upon the brain, I need scarcely observe, that these must likewise be removed ; and this being done, the sore should be immediately dressed, and the patient laid to rest.

We meet with much variety in the directions given both by ancient and modern practitioners for the dressing of sores after this operation. With a view to preserve the dura mater and brain from mortification, various antiseptic applications have been recommended, and dossils or syndons covered with ointments are desired to be introduced, not merely into the perforation formed by the saw, but to be pressed as far as possible in between the skull and dura mater. The impropriety, however, of this, must at once appear obvious

vious from the slightest attention to the effects of it. The sole object of the operation is to remove compression from the brain ; now the dressings that I have mentioned, namely, dossils of lint crammed into the different perforations, must evidently counteract this, not only by the pressure which they produce, but by serving to prevent that free discharge of matter after the operation, upon which the safety of the patient in a great measure depends. Instead of this, the dressings should be of the mildest kind, and as loosely applied as possible.—Dry lint is commonly employed ; but it excites less irritation, and is more easily removed, when thinly spread with a simple liniment of wax and oil ; and no detriment ensues, as some have imagined, from the application of unctuous substances to the brain. No tent or dossil, as I have just observed, should be inserted into the perforation ; all that is necessary is to apply as lightly as possible over the sore, a pledget of soft lint spread with an ointment such as I have mentioned ;

tioned; and this being covered with a thin cushion of soft tow, the whole should be retained with a common nightcap, made so as to tie below the chin, to be either pinned or tied of a proper tightness, on the fore or back part of the head. —This supports the dressings with sufficient firmness; and it neither keeps the head too tight, nor prevents a free flow of matter from the sore, an inconvenience very apt to occur from the use of those bandages commonly employed after this operation.

The patient, on being removed to bed, should have his head placed in such a manner as to prevent the sore from being hurt; while his position ought also to be such as will most effectually tend to discharge any matter that the sore itself may afford, or any blood or serum that may ooze from the surface of the dura mater.

When the symptoms under which the patient has laboured have arisen entirely from a depressed portion of bone, and when this depression has been completely removed,

removed, we commonly find that immediate relief is derived from the operation. From being perfectly torpid, with a deep laborious breathing, and a considerable dilatation of the pupils, the patient becomes less stupid and lethargic. He begins to toss about in bed,—to raise his eye-lids,—and to make some feeble attempts to speak: His breathing becomes less oppressed, and the pupils contract when exposed to a strong light.—But although all these favourable circumstances do not appear immediately after the operation, we are not to despair of success; for when the brain has been long compressed, it does not always recover its functions immediately on the cause being removed by which the compression was produced: And, besides, it often happens, that together with a fracture and depression of the skull, the brain has received a violent shock or concussion; in which case, as the symptoms do not depend entirely on the compressed state of the brain, so it is reasonable to suppose, that other means must be necessary for
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their removal, after every cause is taken away by which compression could be produced : With the aid of these, which hereafter we shall have occasion to consider, the most alarming symptoms are frequently removed at last, which resist for a considerable time the most powerful remedies we can employ.

A surgeon ought not therefore to imagine that all his business is over when the operation is finished ; for this may be done in the most complete manner, and yet the patient will certainly die unless other means are employed for his relief : When the symptoms for which the trepan was applied, become less violent on the depression of the skull being removed, and if the patient in the course of a few hours becomes still more relieved, there will be much cause to hope that he will recover without any other remedy being employed ; and that quietness, keeping an open belly, and avoiding every cause of inflammation, will at last prove sufficient for the cure : But when the reverse of this takes place,

place, when the symptoms remain equally formidable after the operation as they were before, and especially if they do not become more moderate in the course of a few hours after the patient is laid to rest ; remedies of a different kind become necessary.

As the symptoms which in such circumstances are most to be dreaded, originate from two different causes, and as the choice of remedies to be employed for its removal should depend entirely on its real nature, it ought in every instance to be ascertained with as much accuracy as possible.

The causes to which I allude, are, inflammation of the membranes of the brain, and concussion of the brain itself.

In general, the symptoms which prevail here, are all suspected to proceed from the same cause ; they are supposed to be entirely of the same kind, and the same set of remedies are therefore commonly employed in the cure. The impropriety of this, however, is obvious : For although it often happens, that the symptoms

toms are of a mixed nature, and depend so much on a concurrence of both the causes I have mentioned, that they cannot be rightly distinguished, yet in various instances it is otherwise; and when an evident distinction is perceived, much advantage will accrue, from practitioners directing their attention towards it.

After all the evident causes of compression are removed, if the pulse is slow and soft, if the patient remains torpid, and especially if the pupils do not contract on exposure to a strong light, there will be much cause to suspect that commotion or concussion of the substance of the brain has taken place: For although all of these symptoms are occasionally induced by a compressed state of the brain, yet we know that they are likewise the frequent consequences of concussion: So that, when all the depressed bone and other obvious causes of compression are removed, we conclude with much probability, that any symptoms which remain, when they

are such as I have mentioned, depend more upon concussion than on any other cause.

But when, instead of these symptoms, there is, along with some return of sensibility, as is indicated by the patient's becoming unmanageable, and often moving from one part of the bed to another; if the pulse is firm, full and quick; if the eye is found to be inflamed, and especially if the pupil is observed to contract more than usual, and the patient to withdraw his head on the eye being exposed to much light; there will be much cause to suspect that inflammation of the membranes of the brain has taken place. Indeed the dura mater, like every other membrane, is so susceptible of inflammation, that it is difficult to imagine how any part of the skull can be beat in upon it, without irritating and inflaming it in a remarkable degree; and if once inflammation is induced upon part of this membrane, we know from experience that it readily and quickly extends over the whole of it; a circumstance that

that easily accounts for the high degree of inflammation, which is often observed in the eyes, as likewise for the contraction of the pupils, and severe degree of pain which exposure of the eyes in this situation to much light never fails to produce.

When the symptoms proceed from inflammation alone, the pulse, as I have observed above, differs materially from the pulse of a person suffering merely from concussion of the brain. In a state of concussion, the pulse is full, slow, and soft; but when inflammation takes place, the pulse, although frequently full, has a firmer stroke, and is commonly quick and hard: And in this case the breathing, although not oppressed and laborious as it frequently is when the brain is compressed, is always more frequent than natural; a circumstance not commonly observed in patients labouring under the effects of concussion.

Although, for the reasons that I have given, it may often be difficult or even impossible to mark the existence of these

different sets of symptoms, yet an attentive observer will frequently be able to distinguish them; and whenever it can be done, much advantage may be derived from it.

Practitioners of every age have advised in injuries done to the head, to discharge a good deal of blood; and there is reason to think that no general rule had ever a better foundation: But from attentive observation of the effects of blood-letting, I have cause to imagine that surgeons of modern times frequently carry it too far. Where the membranes of the brain are really inflamed, the propriety of discharging much blood is obvious, and will not be disputed; but whenever there is reason from the nature of the symptoms to imagine that they proceed from concussion, blood-letting, if recommended at all, should be practised with much caution.

Although the general structure of the brain with respect to its figure, size, and other circumstances, has long been well known; yet it must be confessed, that

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our anatomical knowledge of this organ is still very deficient, nor have we the most distant idea of the manner in which it performs its various functions. Indeed our knowledge of this part of anatomy is so very lame, that we are frequently perfectly unable to discover, by the most minute dissection, any difference between the brain in its soundest state, and that state of it in a person evidently killed by a fall or blow upon the head, and in whom all the symptoms induced by the accident were such as indicated an affection of the brain alone. This is particularly the case in those who die from what is termed Concussion or Commotion of the Brain. In such instances the brain we suppose to be somehow or other deranged; but it most frequently happens, that the most accurate dissection cannot discover the nature of this derangement, nor in what it consists.

From this it is obvious, that the effect of concussion of the brain is not an excitement of inflammation; for every stage

of inflammation becomes obvious to dissection, and can scarcely indeed escape notice. Now, as it often happens in those whom we suppose to have died from concussion, that no appearance of inflammation in any part of the brain is discovered, it is not unfair to conclude, that the effects of these two causes, inflammation and concussion, are distinct, and perhaps very opposite in their nature and effects.

From the circumstances I have mentioned of the effects observed upon dissection to arise from these causes, and of the symptoms induced by the one being different from those which arise from the other, the conclusion I have formed with respect to their difference, might even upon these grounds be supposed to be well founded: But it is not on speculation alone, that I wish to rest either this or any other opinion of practical importance. The idea was first suggested by the different effects which I had observed to proceed from blood-letting in affections of the brain produced by external violence. In many,
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great advantages ensued from it, while no benefit was procured from any other remedy : But in others, instead of benefit being derived from it, the patients became obviously worse after every repetition of the operation. The pulse, from being full, gradually became weaker ; and the strength of the patient commonly sinking in the same proportion, he seldom recovered from the effects of blood-letting, whenever it was practised to any considerable extent.

From these circumstances I have been led to think, that concussion of the brain operates upon the system, in nearly the same manner with syncope induced by fear, inanition, or any similar cause, in the treatment of which, blood-letting is known to prove hurtful.

In what manner a blow upon the head or a fall from a height, in a full habit of body, and in a person otherwise in perfect health, who only a few minutes before could have supported the loss of much blood, should be able instantly to induce such a state of the system as cannot admit

of this evacuation, I will not pretend to say: But that it frequently happens, I am now from repeated observations entirely convinced; and whoever pays due attention to this branch of his profession, will find that it is so. He will find, indeed, that all such symptoms as arise from inflammation, are more effectually relieved by blood-letting than any other remedy: But he will for certain observe, that all of those which do not depend upon this cause, and which arise solely from concussion, instead of being relieved by this remedy, will be uniformly rendered more obstinate and more alarming, in proportion to the quantity of blood that is taken away.

So far, however, as my experience goes, the evacuation produced by purgatives never proves so debilitating as to render them improper: And as they have frequently an influence in relieving the head, they should never be omitted, and should always be prescribed in such doses, and these as frequently repeated, as the strength of the patient will permit; but

but they should never be carried so far as to run any risk of inducing debility and languor.

In the following sections, I shall have occasion to enter on a more particular consideration of the symptoms induced by inflammation of the membranes of the brain, and by concussion of the brain itself; but these general remarks upon the subject, appeared to be necessary here, with a view to explain the nature of our practice in the treatment of those symptoms which proceed from either of these causes, when connected with a compressed state of the brain, and when, accordingly, the operation of the trepan is not found to afford such complete relief as it otherwise would do. Postponing, therefore, a particular detail of the remedies to be used in cases of inflammation and concussion of the brain, I shall now shortly remark, that whenever the operation of the trepan fails in relieving the symptoms for which it is employed, as this gives reason to believe that they proceed from one or other of these

these causes, we ought in the most particular manner to discriminate between them. When inflammation is found to have taken place, blood-letting, both general and local, becomes requisite, together with smart purgatives, mild sudorifics, and a strict attention to an antiphlogistic regimen: But when the symptoms appear to arise from concussion, the only evacuation that can with propriety be advised is gentle purging; for in this case, as I have already remarked, and as I shall afterwards endeavour more particularly to shew, blood-letting, instead of proving useful, very constantly does harm.

In both situations, as well as in every other requiring the trepan, the patient should be kept perfectly quiet,—little or no light should be admitted to his apartment,—any food he is able to take should be of the mildest kind, and plenty of whey or any other diluent drink should be allowed.

In the mean time, the state of the wound requires particular attention; for after the
operation

operation of the trepan, the membranes of the brain are not only liable to inflame, but to become gangrenous. In wounds of other parts of the body, we know that nothing so certainly prevents inflammation and gangrene, as a free suppuration being induced upon the injured parts ; and whoever will prosecute this practice in wounds of the head, will find, that although, from the nature of the parts that have suffered, it may not prove equally useful, that it will, however, answer better than any other that has as yet been employed.

With this view, warm emollient poultices and fomentations should be applied over the dressings, and renewed every two or three hours ; which soon tends to promote a plentiful flow of matter from the perforations in the skull, by which the tension is soon removed, at the same time that the other symptoms are rendered less violent.

At every dressing, the matter resting in the perforations should be removed with a piece of soft sponge or lint, and thereafter
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the fore should be speedily covered with a pledget of any mild ointment.

When the cure goes properly on, granulations soon appear upon the dura mater as well as on the rest of the wound; and these continuing to advance, the different openings made by the trepan are at last completely filled up, and the whole being brought to a level with the rest of the teguments, a cicatrix is thereafter obtained by the same means that prove successful in other parts of the body, and of which I have already given a detail *.

These granulations, however, which in general arise from the dura mater only, and not from the brain itself, as has commonly been supposed, instead of merely filling up the openings in the bone, in some cases push out beyond the surface of the teguments, so as to form distinct pendulous tumors.

These tumors or excrescences, when they become large, prove sometimes troublesome, and various means have been
proposed

* *Vide* Chapter IV.

proposed for their removal. Being commonly considered as productions of the brain itself, much caution has prevailed in remedies that have been employed for them. Compression is most frequently advised. In some instances they are kept down with escharotics, and in others with strong caustic. Some have proposed to remove them with ligatures, and others by excision.

Of all these modes of treatment, that by compression is most to be dreaded, and ought certainly to be exploded: For whether the tumors arise from the brain or dura mater, pressure cannot be applied to them without affecting the brain; and we commonly find, that even the slightest degree of it induces headach, sickness, and in some instances convulsions. It ought not therefore in any case to be advised.

These tumors are of various degrees of sensibility. In some, they are painful, and cannot bear to be touched; whilst in others they are almost destitute of sensibility. In this last case, the most effectual
treatment

treatment is to touch them daily with lunar caustic, or calcined alum, and when the tumor hangs by a small neck, it may with safety be removed with a ligature.

We seldom, however, find it necessary to employ any of these means ; for in general the tumors begin to diminish as soon as the soft granulations in the perforations of the skull begin to acquire a firmer consistence ; and by the time the ossifying process of this substance is completed, they commonly drop off solely by the pressure which this never fails to produce. We should not, therefore, in any case, proceed quickly to remove them ; but when they do not fall off on the different perforations being filled with bone, as the connection between them and the brain is then in a great measure cut off, they may accordingly be removed with more safety, either by excision, caustic, or ligatures.

The cure being thus far complete, if the method that I advised was adopted, of saving all the skin and other teguments, a narrow cicatrix only will remain, and the
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parts will be nearly as firm as they were before: But when much of the skin and muscles have been destroyed, as these parts are never renewed, the bone will be left covered by a thin cuticle only, with perhaps a very small proportion of intermediate cellular substance; in which case a piece of tin or lead, lined with flannel, should be fitted to the part, with a view to protect it from the effects of cold and external injuries.

When the symptoms arising from injuries done to the head, proceed entirely from a depressed portion of bone acting as a cause of compression upon the brain; if this can be removed, a due perseverance in the plan of management that I have proposed, will in general answer. I must, however, allow, that they do not end in this favourable way so frequently as we could wish: For, along with the depression of the skull, we often meet with symptoms, as I have observed above, either arising from concussion, inflammation, or gangrene; circumstances at all times attended

tended with uncertainty, and commonly with much hazard.

We now proceed to consider the other general cause of compression of the brain, namely, extravasation.

§ 2. *Of Compression of the Brain from Extravasation.*

By whatever cause the brain may be compressed, the symptoms that ensue are nearly the same; and as these have already been minutely considered, it will not be necessary to enumerate them again. I shall only observe, that all the symptoms arising from a compressed state of the brain, are induced with equal certainty, and attended with as much hazard, from effusions of blood, serum, or pus, as from the most extensive depressions of bone. Those symptoms indeed that occur from extravasation are more to be dreaded than depressions of great extent; for when a depressed portion of bone is large, the seat
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of the injury is for the most part easily known, and by proper means may often be removed; but where extravasation takes place, our means of ascertaining the seat of the injury are more uncertain, so that the effects of our remedies are less to be trusted. When indeed the brain is compressed by a complication of these two causes, a depressed portion of bone, and extravasation of blood or serum, the seat of the one is readily discovered by that of the other; but when compression is formed by extravasation alone, it is always difficult, and often impossible, to discover the seat of it.

A complication of these two causes is by no means uncommon; for extravasation of blood or serum is a frequent effect of fractures or depression; but we likewise meet with instances of both being effused on the surface of the brain, without any injury being done to the bone.

In compression of the brain from extravasation, we have the same object in view, with that which a depressed portion of the

skull renders necessary: Having endeavoured to ascertain the seat of the injury, we are to make one or more perforations, in order to discharge the extravasated fluid, and this being done, we are to guard against any effects which the operation might produce upon the brain and its membranes.

It sometimes happens, that the part in which the collection is seated, is pointed out by the mark of a blow or bruise; and on the bone being laid bare, a fissure will in some instances be found in it, while in others no other injury is discovered, farther than a separation of the pericranium from the surface of the bone.

When any of these circumstances however take place, we should consider the seat of the injury to be so far ascertained as to have no hesitation in fixing upon this spot for applying the trepan; but, in some cases, no external mark of injury is discovered: even after the whole head is shaved, and minutely examined, the skin will
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in various instances be found perfectly found, without any appearance either of tumor or discoloration.

Hitherto it has been held as an established maxim, never to apply the trepan in compression of the brain from external violence where there is no external mark to point out the seat of the injury, the result of the operation being in such cases always uncertain: But as compression of the brain, if not removed, must soon terminate in death, and as it cannot be removed in any other way than by perforating the skull, in such circumstances, to leave any thing undone which would give even the smallest chance of saving the patient, shews a degree of indifference not in any other instance met with in the surgery of modern times. It is with truth indeed said, when no external injury takes place, that there is always much uncertainty of any perforation we can make being to fall upon the spot where the cause of compression takes place; that as the symptoms induced by concussion, are of-

ten highly similar to those arising from compression, much dubiety must occur from our not being able to say with precision, whether the symptoms depend upon one cause or the other; and it must be confessed, even where the symptoms have previously been supposed to arise from compression, that in many instances no vestige has appeared on dissection, either of depression of the skull, or of effusion of blood or serum.

All this I shall admit; but to what does it amount? Why, to no more than this: That where a patient is evidently in much danger, and is to die if means are not employed for his relief, wherever there is much uncertainty in the effects of these means, that it will be better not to advise them, but rather to leave the patient to his fate! As long as the state of a person in this situation affords cause to hope that he may recover by other means, it would no doubt be improper to employ the trepan; or if much additional risk was to be incurred by the operation, no practitioner

tioner of character would advise it with so little probability of any advantage being to arise from it.

But as a patient labouring under the symptoms I have described, cannot be relieved by any other means, and in such desperate circumstances as no additional hazard can be incurred from an operation, we ought certainly, in justice to the patient, to his friends, and to our own reputation, to advise it. The chance resulting from it, will not indeed be great; but being the only means from whence safety can result, by employing it lives may be saved which otherwise would be lost; and if a prognosis sufficiently guarded is given, no just blame could fall either upon the operator, or on the art. If the friends of the patient should be told of the hazard he is in; that he may, however, have some small chance of recovering, if the trepan is applied; even under this doubtful prognosis, they would in a great proportion of cases wish to have it done; and however unsuccessful it might prove,

and although no extravasation, or other cause of a compressed brain, should be met with, a prognosis of this kind would in every instance screen the operator from blame: and having thus done all that could afford any chance of his recovering, the friends of the patient, as well as the surgeon himself, would surely have more cause to be satisfied than if no attempt had been made for preserving him.

I shall therefore suppose that the trepan is to be applied for the removal of symptoms arising from a compressed state of the brain; but where no external mark indicates the particular seat of the injury, it may be asked in what manner are we to proceed? As the cause of compression may exist just as readily in one part as another, it may seem to be a matter of little importance in what part of the head the first perforation is made. This, however, is far from being the case: For, as we are supposing the compression to be induced by blood or serum, and as these, while in a fluid state, are always passing

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as much towards the basis of the brain, as the intimate connection between the dura mater and the internal surface of the skull will permit; it will be proper to form the first perforation in the most inferior part of the cranium in which it can with any propriety be made, and to proceed to perforate every accessible part of the skull, till the cause of compression is discovered. For this purpose there is no necessity, as I have already observed, to remove any part of the integuments: Wherever we mean to perforate the bone, if an incision is made through the skin, muscles, and pericranium, they will retract sufficiently for admitting the instrument; and this being all that is necessary, more should not be done. If we are at last so fortunate as to meet either with blood or serum, much care should be taken to discharge it; for which purpose, as blood, when coagulated, frequently adheres to the dura mater, instead of one perforation, two, three, or more should be advised, so as to

admit of all the extravasated blood being removed.

But in such circumstances the operator should likewise recollect that the blood, instead of being effused on the surface of the dura mater, may be collected within the cavity of that membrane; or it may even be contained within the pia mater, in immediate contact with the brain. For which reason the state of the dura mater should be examined with attention, after every perforation. If it is found to be of its natural colour, and not more tense than it ought to be, nothing farther should be done; but if very tense and elastic, and especially if it has that dark or livid appearance which indicates the probability of blood being collected beneath, it ought undoubtedly to be opened, in order to discharge it. The best and easiest mode of doing this, is to scratch a small hole by repeated strokes with a lancet: This being done, and the point of a pair of curved scissors being introduced beneath the dura mater, the opening may thus be enlarged
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to the full extent of the perforation in the bone ; or if one cut across the perforation is not sufficient for discharging the blood beneath, a crucial incision may be made, and, if necessary, the corners thus produced may be cut off.

Although I would not recommend the division of the dura mater, where not necessary for the safety of the patient ; yet, in every instance where the operation of the trepan is advisable, if, on perforating the bone, there is reason to suspect that a fluid is collected either between this membrane and the pia mater, or even below the pia mater itself, as the intention of the operation would not otherwise be fulfilled, the collection, of whatever it may consist, ought immediately to be discharged : In such circumstances, unless we go this length, we in fact do nothing : for the dura mater is so thick and strong, that any blood or matter collected between it and the brain, would more readily spread inwards, than burst out through the different layers of this membrane.

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To this practice it has been objected, that few have recovered where it has been carried into effect ; that there is a risk of fatal hemorrhagies being induced by it ; and that the brain is apt to protrude at the perforation in the bone, after it has lost the support of its surrounding membranes.

That few have recovered by this means, I will allow : But this does not proceed so much from the opening made in the dura mater, or from this part of the operation being particularly hazardous of itself ; but, from the cause for which it is employed being productive of such danger as puts it out of the power of art, either by this or any other means, to obviate the fatal effects of it.

With respect to hemorrhagies being apt to ensue from this practice ; although I have seen the dura mater opened in several instances by others, and have different times done it myself, I never knew an instance of its doing harm, not even when any of the sinuses have by accident
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been laid open; and although the brain will no doubt protrude more readily when the dura mater is divided, than it otherwise might do, yet this we know is a frequent occurrence in every wound where much of the cranium is removed, and that considerable portions of the brain have been even discharged by wounds, without any material harm being done by it.

The result, therefore, of all that can be said upon this point, is, that where the intention of the operation is fully answered by perforating the cranium; where any portion of bone that has been depressed is thus completely removed; or where any pressure produced upon the brain is found to proceed from blood or serum on the surface of the dura mater; as in any of these cases the cause of danger can be removed without penetrating this membrane, it ought not by any means to be done: But whenever the bad symptoms which have prevailed are not relieved by the perforation of the bone; or by the removal of any effused fluid that may be met

met with on the dura mater; and when from the appearance of this membrane there is cause to suspect that a fluid is collected beneath; it ought undoubtedly to be opened. Even although the inconveniences resulting from it were greater than they have ever been, when the life of a patient appears to depend on it, something ought to be hazarded: But we have seen that the risk attending this part of the operation is of little importance; so that I would consider any practitioner as culpable who would advise it to be omitted, when a patient in these circumstances has not been relieved by the previous steps of the operation.

In this situation our views should be exactly such as ought to direct us in the treatment of abscesses in other parts of the body. When a patient is suffering with matter collected in a particular part, no surgeon of experience will be deterred from going to the full depth of the collection merely from finding that it is more thickly covered than he had reason to expect

pect before the skin and cellular substance were divided. He will proceed more slowly and with much caution; but he will at last reach the seat of the matter with as much certainty as if it had been more superficially situated.

In like manner, when there is cause to imagine, that matter is collected beneath the membranes of the brain, an incision should for certain be made through them. No additional risk can be incurred from it: Some few may be saved by it; and at any rate, it must always afford satisfaction, not only to the friends of the patient, but to the practitioner himself, to know that nothing has been omitted from whence any advantage could be derived.

It will often indeed happen, that neither this, nor any other effort of art, will obviate the danger of the patient. But when the principles upon which an operation is founded are evidently just, and when, on mature deliberation, it appears, that a patient may be saved by it, and
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that he cannot escape by any other means, it is not the frequency of its success alone by which we are to be directed: The danger induced by the cause for which it is employed is the object to be kept in view; and every practitioner who acts solely for the good of his patient, will at all times employ such means as are best calculated for the removal of this danger, without paying attention to any other consideration. If it were the object of surgeons to operate only where certain success would ensue, many lives would be lost that otherwise are saved; and in that case the practice I thus wish to inculcate, of applying the trepan in injuries done to the brain, where no external mark of direction exists, would no doubt be inadmissible: But as the safety of those intrusted to us ought to be our first and great object, and professional fame only a secondary consideration, whenever we are certain that death must ensue, if not prevented by the timely application of a proper remedy, although there may be

be no great certainty of this remedy proving successful, yet if it is the only means from whence there is a chance of safety, it ought undoubtedly to be employed. It is on this principle solely that I have advised the practice of perforating the skull in different places, when, in a compressed state of the brain, the part chiefly affected is not pointed out by some external mark of injury: And although the opinion I have thus ventured to give is not agreeable to general practice, yet as this practice has ancient custom only for its support, being in every other respect apparently ill-founded, the advantages which may accrue from a different mode of treatment, will only require, as there is reason to hope, to be thus fully pointed out, in order to procure it a favourable reception.

Having fully adverted already to the after-treatment of cases in which the trepan has been applied for the removal of a depressed portion of the skull, it will not be necessary to enter upon the subject again; for

for whatever the cause may be for which the operation is practised, the cure of the remaining fore ought to be conducted in the same manner.

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SECTION IV.

Of Concussion or Commotion of the Brain.

EVERY affection of the head attended with stupefaction, when it appears as the immediate consequence of external violence, and when no mark of injury is discovered, is in general supposed to proceed from commotion or concussion of the brain; by which is meant such a derangement of this organ as obstructs its natural and usual functions, without producing such obvious effects on it, as to render it capable of having its real nature ascertained by dissection.

Almost all the symptoms commonly produced by a compressed state of the brain, as enumerated in the last section, are in some instances met with from concussion: but those which most frequently arise from it are, stupefaction; torpor

to a greater or lesser degree ; a flow, soft pulse ; and a dilated state of the pupils, even on the eyes being exposed to light.

As it is not always easy, however, to determine from the symptoms, what particular affection of the head may have taken place, I shall endeavour to mark, as far as can be done, a distinction between concussion and inflammation, as well as between concussion and compression, of the brain. It is an object of much importance, and therefore requires our most serious attention.

It is seldom difficult, as we have seen in the last section, to distinguish between the symptoms which proceed from inflammation, and those that arise from concussion.—Such as proceed from concussion alone, commence immediately on the injury being done ; in violent degrees of them, the patient remains totally insensible : the pupils are much dilated, and do not contract even when the eyes are exposed to the strongest light ; and the pulse, although sometimes full, is not hard nor strong,

strong, and it always becomes weaker on blood being taken away.

Those symptoms again which originate from inflammation, seldom appear till several days after the accident: By the description to be more particularly given of them in the following section, it will appear, that they are materially different from those which proceed either from a compressed state of the brain or from concussion. The pupils are not dilated; nay the eyes, excepting in the more advanced stages of the disease, are very sensible to the impression of light; and the pulse is firm and hard from the first, and does not become weaker on moderate evacuations of blood.

By these marks of distinction, as well as others, which an attentive practitioner will commonly notice, little uncertainty can prevail in determining whether symptoms proceed from concussion or inflammation; so that with respect to this point we may soon determine on the practice to be pursued. And again, we can easily

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distinguish between symptoms arising from slight degrees of concussion, and those which proceed from compression. Thus, when a person is knocked down by a blow upon the head, and quickly recovers from the more alarming effects of it, but remains for a considerable time giddy ; with slight pains in different parts of his head ; with tinnitus aurium, weakness of sight ; some degree of imbecillity, and loss of memory ; if no other symptoms occur, and especially if he is able to walk about, as frequently happens even in high degrees of these symptoms ; we conclude from experience in similar cases, that they all proceed from commotion or concussion, and not from compression of the brain ; for the symptoms which proceed from compression are of a more permanent nature, and uniformly continue till the cause which produced them is removed.

But where the symptoms are important from the beginning, and especially when the patient is altogether insensible, if no external mark of injury takes place, it
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is always difficult to determine whether they depend upon concussion or depression. Indeed instances often occur, in which symptoms supposed to originate from concussion, have after death been found to proceed from extravasation, or perhaps from a fracture attended with depression of the skull which had not been previously discovered. And again, symptoms have often been suspected to arise from extravasation, when on dissection, no vestige either of this or any other morbid appearance could be traced.

So far as my observation goes, the most material difference between the symptoms arising from these two causes, concussion and compression of the brain, is met with in the pulse and breathing. In a compressed state of the brain, the breathing is commonly deep and oppressed, similar to what takes place in apoplexy; whereas, in patients labouring under the effects of concussion, the breathing is in general free and easy, and the patient lies as if he was in a sound and natural sleep. The pulse

is commonly soft and equal, and not irregular and slow, as it usually is when the brain is compressed. In a compressed state of the brain, although little or perhaps no relief may be obtained from blood-letting, yet no harm is observed to ensue from it; so that in moderate quantities, it does not reduce either the frequency or strength of the pulse: Whereas in concussion of the brain, the pulse, as I have already remarked, will frequently sink, and become much more feeble on the loss of only eight or ten ounces of blood.

In doubtful cases, therefore, a quantity of blood should be immediately discharged: If the pulse, upon six or eight ounces being taken away, is found to be stronger and fuller than before; if the blood is found to be fizy; and especially if the patient becomes more sensible; we may conclude with much probability, that the symptoms depend either upon extravasation; upon some part of the skull being depressed; or upon some degree of inflammation: and as long as the pulse remains
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firm, and any advantages are gained by it, we may with safety proceed to discharge more blood.

But when the pulse, upon a few ounces of blood being taken, becomes feeble, especially if the patient becomes weak and languid, as almost always is the case when the symptoms proceed from concussion, as the nature of the case is thus rendered in some measure certain, any farther discharge should be immediately prevented.

I have already endeavoured to show, that concussion of the brain appears to operate by inducing debility of the whole system; our remedies, therefore, instead of tending to increase this, as blood-letting very certainly does, should be such as give additional vigour.

With this intention, in similar circumstances arising from other causes, we would advise not only the internal use of cordials, but the outward application of stimulants; and as symptoms of debility in the case we are now considering, are as

strongly marked as in any disease whatever, I am clearly of opinion, that cordials, and even stimulants, are equally necessary in the method of cure.

Many practitioners have acknowledged, that although they have by general custom been induced to take blood freely in all injuries done to the head, that in various instances no benefit has been derived from it, and in some that it has even done harm. Having met with many instances of this, in which all evacuations of blood sunk the strength of the patient in an alarming manner ; and finding indeed, unless where the symptoms arose clearly from inflammation, that few, if any, recovered, when the practice of discharging much blood was carried far, I was induced in the first place to see what would result from no evacuation of blood being advised, and trusted chiefly to laxatives, and a gentle moisture being kept upon the skin. On finding that no bad effects ensued from it, and, even that more patients recovered than had commonly done from blood-letting, I
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was thereby induced to carry the practice farther.

Upon this principle, cordials were given internally : stimulants, particularly blisters, were applied externally, in the same manner as is usually done, in debility proceeding from any other cause ; and hitherto the effects that result from it have been such as sufficiently warrant a continuance of the practice.

In every case, therefore, where concussion of the brain appears to be the cause of the symptoms, the practice I would recommend is, to exhibit in a gradual manner such quantities of warm wine as would appear to be proper for the same symptoms of debility induced by any other cause : As patients in such circumstances are apt to become cold, they should be kept warm by proper coverings : A blister should be applied over all that part of the head of which the skin has not been injured ; sinapisms should be applied to the feet ; and although strong purgatives would be improper, by tending to reduce the strength
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of the patient, yet gentle laxatives prove always useful, and should be regularly given, when the state of the bowels requires them.

As wine is a cordial upon which we can place more dependence than on any other with which we are acquainted, it ought in this, as in every case where cordials are required, to be preferred. But although with due pains, by opening the patient's mouth, and putting it in with a spoon, it may in almost every case be exhibited; yet occasionally we meet with instances in which it cannot be swallowed in sufficient quantity: In this case the volatile alkali, ardent spirits, and other cordials of a more active kind, should be given.

In concussions of the brain, Mr Bromfield has recommended the use of opiates; a circumstance which tends much to corroborate the opinion I have endeavoured to establish of the nature of this affection; for few medicines act with more certainty as cordials than opium: When conjoined with antimonials, I have frequently found it
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prove useful ; but although I have upon such respectable authority employed opium by itself, I have not hitherto found it answer so well as wine. This, however, may proceed, either from my not having pushed the use of it so far as I ought to have done ; or from the few cases in which I have employed it having been such as would not have done well whatever remedy might have been used. I must, therefore, have farther experience of its effects before venturing to speak of it with more decision.

Issues are commonly advised here ; but as more advantage I believe is to be derived from the stimulating powers of blisters, than from any discharge which they produce, instead of preserving a blistered part open, with issue-ointment, as is usually done, I would prefer a repeated and frequent renewal of blisters on different parts of the head and neck. In this manner, any advantage to be derived from them as drains, will be equally certain as from issues ; and by applying one blister
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on another being nearly heal, almost a constant stimulus will be kept up.

In the progress of the cure, we sometimes derive advantage from a liberal use of bark and steel mineral waters. Gentle emetics have likewise proved useful; and when much languor, inactivity, and loss of memory, have continued more permanent than usual, electricity has been employed with advantage.

It must however be remembered, that, in recommending this practice, it is expressly for the removal of symptoms that arise from concussion, and that do not depend either upon a compressed state of the brain or on inflammation; a circumstance which may in general be so far ascertained as to render it obvious whether such a course is proper or not, merely by the effects that are observed to result from blood-letting. Attentive observation of other circumstances might in some instances enable us to decide upon this point, without the necessity of having recourse to this means of distinction; but where
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there is such room for uncertainty as frequently prevails here, and where the life of a patient is to depend on the practice to be pursued, nothing ought to be omitted that can tend to establish an accurate knowledge of his situation. In such circumstances, therefore, there is no room to hesitate; so that where much doubt and uncertainty take place, as much blood should be discharged as may tend to determine the nature of the case.

This is the practice I would always advise for the removal of symptoms arising solely from concussion: And accordingly, I have not thought it necessary to mention the use of the trepan; for although it is very universally advised, yet unless where symptoms take place of a compressed state of the brain, no good reason can be assigned for it. But in cases of doubt and uncertainty, and especially where a patient remains comatose and insensible, the trepan ought by all means to be employed; for as in these circumstances it could not add to the danger; and as it affords the only chance

chance of safety in symptoms arising from compression, practitioners would be highly blamable were they not to advise it; and as the hazard of the patient must here be imminent, perforations should be made in every accessible part of the skull as long as the cause remains undiscovered.

We now proceed to consider more particularly the effects of inflammation upon the brain.

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SECTION V.

*Of Inflammation of the Membranes of the Brain
from external Violence.*

INFLAMMATION in every part of the body demands particular attention, more especially in organs of importance; for its effects being in general violent and rapid, if not quickly removed they commonly end in more permanent distress:—If this is the case in parts of less importance, it is more particularly so in inflammation of the membranes of the brain.

Inflammation of the brain and of its membranes is apt to produce all the symptoms that commonly occur in inflammatory affections of other parts, while at the same time it excites a set of symptoms in some degree peculiar to itself. By whatever cause inflammation of the brain or of
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its membranes may be induced, the symptoms do not appear immediately; seldom indeed till several days after the injury, and often not till two, three, or more weeks, have elapsed; a circumstance, I must again observe, that serves with more certainty than any other to distinguish inflammation of these parts from every other affection to which they are liable: For, while the symptoms of inflammation approach by slow degrees, the effects of concussion succeed instantly to the injury by which they are produced; and this is also the case with those symptoms that proceed from a depressed portion of bone, or from extravasation of blood or serum.

At some uncertain interval, of two or three days, in some cases of as many weeks, and in a few instances of two or three months from the date of the injury, the patient begins to feel an universal uneasiness over his head, attended with listlessness and some degree of pain in the part that was hurt, but of which perhaps he
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has not till now had any cause to complain.

The listlessness becomes more remarkable,—the patient appears dull and stupid,—and the pain becomes more severe in the injured part; while in other parts of the head a sensation of fulness takes place as if the brain was girded or compressed: The patient complains of giddiness, nausea and retching. He finds himself hot and uneasy;—his sleep is disturbed,—and he is not refreshed either with what he enjoys naturally, or by what is procured with opiates. The pulse is firm, or rather hard and quick, as it almost always is indeed in inflammatory affections of membranous parts: The face is commonly flushed,—the eyes are from the beginning somewhat inflamed,—and exposure to light creates a good deal of pain.

Where the symptoms are accompanied with a wound of any part of the head, this flushing of the face and inflammation of the eyes are apt to be attended with and seem to depend upon an erysipelatous af-

fection proceeding from the fore : In which case the edges of the wound first become hard and tumefied ; and the swelling, which appears to originate in the aponeurotic expansion of the muscles of the head, spreads quickly over the whole of it, especially towards the eyelids ; which often become swelled to such a degree as to shut the eyes entirely. This swelling is somewhat soft, and receives with ease any pressure that is made on it :—It is painful to the touch,—and the skin over the whole of it has an erysipelatous degree of redness.

This diffused swelling, however, although formidable in appearance to those who are not versant in this branch of practice, does not in general prove so dangerous, as that puffy circumscribed tumor to which the parts that received the blow are more especially liable ; for this erysipelatous swelling, which extends over almost the whole head, proceeds most frequently not from any thing bad within the skull, but merely from the external wound in
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the tendons or muscles: In which case all the symptoms that take place, very commonly vanish by the effect of those means which usually answer best in erysipelas in other parts. In a few instances, however, this symptom appears to arise from an affection of the dura mater; in which case its tendency is always of the most dangerous nature, and therefore requires our most serious attention.

Soon after these symptoms have taken place, the part which received the blow begins to assume some appearances of disease. If the bone has been laid bare, it is now observed to lose its natural healthy complexion: It becomes pale, white, and dry, either over its whole surface, or in particular spots which by degrees extend over the whole; and the edges of the sore, from the first commencement of the symptoms, become hard, dry, swelled, and painful: But when the bone has not been denuded, and when none of the softer parts have been divided, but merely contused, they now begin to swell, become puffy,

somewhat painful to the touch, and if the head is shaved, the skin is observed to be of a more deep red than in the rest of the head: If, in these circumstances, the swelled part is now laid open, the pericranium will in all probability be found detached from the skull; a small quantity of a thin, bloody, and somewhat fetid ichor will be found between this membrane and the bone; and the bone itself will be discoloured in nearly the same manner as if it had been laid bare from the beginning.

With proper assistance, all these symptoms are for the most part soon carried off; but when either neglected from the beginning, or when not quickly removed, they very constantly become worse. The pulse still continues quick and hard; the patient becomes more and more restless; and in some instances, delirium takes place. His skin is in general hot, but at times he is seized with shiverings, which gradually become not only more severe, but more frequent, and at last they are commonly succeeded by coma or stupor.

About

About this period all these symptoms either become so much milder as not to be distinctly observed, or they are altogether lost in those that ensue.—Paralysis of one side is not unfrequent; the pupils become dilated, and are scarcely affected by the impression of light; the urine and fæces are passed involuntarily; subultus tendinum and other convulsive symptoms take place; and, if the patient is not speedily relieved, death very quickly ensues.

These are the most frequent symptoms arising from inflammation of the membranes of the brain. Others are met with in particular instances; but those that I have narrated are the most frequent, and they serve to mark the presence of the disease with sufficient precision.

In this enumeration, attentive observation will readily distinguish two sets of symptoms; each of which is connected with and clearly points out a particular state or stage of the disease. The one I would name the Inflammatory state, and

the other the Suppurative or Purulent state.

In the treatment of these symptoms, it is of much importance to attend to this distinction. It ought to serve indeed as the basis of our practice, in so far as the remedies to be used in the one stage of them are improper or even inadmissible in the other.

During the prevalence of inflammation, we rely chiefly on the effects of blood-letting; but we ought to abstain from it, when the disease has advanced to suppuration. In this state the operation of the trepan can alone give relief; while during the continuance of inflammation, it is not only useless, but might even do harm. I shall hereafter, however, have occasion to speak more particularly of this.

External violence may induce inflammation of the brain and its membranes in three different ways; by depressed portions of the skull irritating the dura mater; by contusion; and by simple fissures or fractures of the skull not attended with depression.

depression. The first of these we have already considered, and I shall now proceed to treat separately of the other two.

§ 1. *Of Contusion of the Head.*

It is not those slight contusions which affect the teguments of the head only that we are now to consider: It is such only as in their consequences prove formidable by communicating inflammation to the membranes of the brain that it is here necessary to mention.

A contusion of the head may be produced in the same manner with contusions of other parts; by falls, blows, and by stones or other missile weapons thrown from a distance. It may be attended with wounds of the skin and other teguments; or the skin, as most frequently happens, may be left entire.

The most frequent effect of those blows upon the head that afterwards end in danger, is instantly to deprive the person of

his senses, who complains, on his beginning to recover from this, of some degree of giddiness, which continues for a longer or shorter period, according to the degree of violence which the brain has suffered. In a gradual manner, however, the patient recovers so as commonly to be nearly well after a night's sleep; and unless a wound has been produced along with the contusion, he seldom or never complains of the part on which the injury fell, till several days after the accident.

The time that intervenes between a blow being given and the commencement of the after-symptoms is very uncertain: These symptoms all originate from inflammation, and this again makes a slow or rapid progress according to the violence of the cause, and habit of body of the patient. Hence, in some cases, the inflammatory symptoms appear in the course of a day or two; whilst, in others, the patient continues perfectly well for several weeks, and at last is seized with pain and inflammation of the part that was first hurt,

hurt, and from which alone all the train of bad symptoms proceed that I have mentioned: Nay, instances have occurred of cases of this kind ending fatally, in which no appearance of any thing morbid was observed on the part that received the blow, till the eightieth, ninetieth, or even till the hundredth day from the accident.

Hence, it is evident, that much danger may arise from injuries done to the head, which do not at first exhibit any suspicious appearance: A circumstance that points out the propriety of paying the most accurate attention to every violence which it receives.

In the treatment of contusions of the head, the indications to be kept in view are,

1. To employ the most effectual means for preventing inflammation.

2. When these do not succeed, we should endeavour to keep the symptoms moderate, and to prevent the formation of matter.

3. When

3. When this proves to be impracticable, and when suppuration takes place, a free vent should be procured for the matter: And,

4. When the injured parts are attacked with gangrene, the most effectual means should be immediately employed for putting a stop to it.

With respect to the first indication, I may remark, that in slight contusions of the head we seldom have it in our power to employ any prophylactic or preventative means. Patients commonly recover speedily from the immediate effects of contusions, and, till the after-symptoms commence, they seldom complain of any thing but a slight soreness in the injured spot. Practitioners are not often informed therefore of the accident till it is too late; and when they are, the patient will seldom submit to any course that might prove useful. But when this can be done, the means we should advise are, blood-letting, both general and local, to a considerable extent;—the use of laxatives, to
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preserve an open state of the bowels ;—the application of a strong solution of cerussa acetata to the part affected ;—a low diet, and total abstinence from every kind of fatigue.

Saturnine and other cold applications are sometimes employed with advantage even where the brain and its membranes appear to be hurt, but they prove chiefly useful, where the injury is confined to the external parts of the head.

By these remedies, the effects of many injuries done to the head might be prevented : But practitioners, as I have remarked above, are seldom called till the bad symptoms have commenced ; the particular treatment of which we are now to consider.

In every instance, we should endeavour, as quickly as possible, to carry off the inflammation ; the most effectual remedies for which are, blood-letting, purgatives, mild sudorifics, and opiates, along with local applications to the injured part.

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In common practice, the blood is, in such circumstances, taken indiscriminately from any part of the body : But by many of our older writers, and even by some of the moderns, we are told, that blood taken from the feet proves more effectual than the same quantity taken from any other part.

This, however, is an idea built upon the erroneous doctrine of derivation and revulsion, which is now very generally exploded. Instead of which, we find, that in every case of inflammation, any blood that we discharge proves most useful when taken from the injured spot. We particularly observe, in injuries done to the head, that much advantage ensues from the blood that is discharged from vessels divided in the operation of scalping, or that of laying the skull bare ; a circumstance which strongly indicates the propriety of local blood-letting in all affections of this kind.

On this principle, when a sufficient quantity of blood can be got by the application

plication of leeches, or by cupping and scarifying near to the injured part, this mode of discharging it should be preferred: But when this cannot be done, we may always succeed by scarifying the parts with a lancet or scalpel; a practice from which I have in different instances derived much advantage, and which I therefore wish, in the strongest manner, to recommend. When the skull is already laid bare by the injury, or when the scalp has been divided in order to discharge any matter collected beneath, there can be no necessity for these scarifications; but when the teguments remain entire, or are only slightly hurt, and are attacked in a particular part with inflammation, scarcely any remedy answers so well as scarifications, which, in order to prove useful, ought to be freely carried into the parts beneath, with a view to divide the largest arteries that can be reached. In this manner, any necessary quantity of blood may be taken, and it proves always more certainly useful

ful than any other mode of discharging it.

When this operation however is not agreed to by the patient, or when general blood-letting may be judged more advisable, it answers best to open the jugular vein or temporal artery. With respect to the quantity of blood to be discharged, this must always depend on the violence of the symptoms and strength of the patient: but in circumstances such as we are considering, as the patient's recovery or death is probably to depend on what is done in a very short space of time, blood-letting, as being the remedy on which our hopes ought chiefly to be founded, should be pushed immediately to as great a length as with safety can be done. Instead of taking eight or ten ounces, and repeating the operation, as is usually done, I always think it right, as I have just observed, to be determined by the strength of the patient, and to draw blood as long as the pulse continues firm. While this continues to be the case, no danger occurs from
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the evacuation; and in all cases of violent inflammation, it answers the purpose with most certainty, to take twenty or twenty-five ounces of blood at once, than to abstract even a larger quantity by repeated operations. In the course of a few hours, again, if the symptoms still continue severe, and if the pulse remains sufficiently full, it may be proper to discharge an additional quantity; but this likewise should be determined by the effects that result from it.

Together with a plentiful evacuation of blood, the bowels should be freely emptied, by brisk purgatives when these can be exhibited; or when they cannot be taken in sufficient quantities, stimulating glysters should be given instead of them. In all affections of the head, it is an object of importance to preserve an open state of the bowels, particularly where inflammation has attacked the brain: It is not, however, an open state of the bowels merely that proves useful. In order to receive much benefit from the practice, a
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smart purging should be kept up, with repeated doses of calomel, jalap, senna, or some of the neutral salts.

As it is found in every case of inflammation, that advantage is derived from the skin being kept soft, it ought always to be advised in an inflamed state of the brain. Perspiration may, for the most part, be induced by warm fomentations applied to the feet and legs, and laying the patient in blankets instead of linen; but when means of this more simple kind do not answer the purpose, more powerful sudorifics must be employed.

In a great proportion of cases, the common effervescent draughts answer sufficiently well, particularly when a few drops of antimonial wine are added to each dose: The *calx antimonii nitrata*, which appears to be the same with Dr James's celebrated powders, is sometimes used with advantage; but nothing acts with such certainty as a combination of opium and antimony, or opium and ipecacuanha, as we have it in the form of Dover's powder.

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This last is recommended by a late celebrated practitioner of London, Mr Bromfield *; and I know from frequent experience, that the other proves often highly beneficial, and that it acts with entire safety.

In severe degrees of pain, large doses of opium become necessary. A general prejudice has till of late indeed prevailed against the use of opiates in all cases of inflammation, particularly in inflammation of the brain; but this seems to have arisen more from an erroneous idea of the proximate cause of inflammation, and of the *modus operandi* of opiates, than from actual observation of the effects which they produce. By exciting some degree of heat, and in some instances increasing the fulness of pulse, it has been supposed that they must always do harm in inflammation; but I can from much experience of their effects assert, that these fears are groundless, and even in inflammation of

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* *Vide* Chirurgical Observations and Cases by William Bromfield, p. 12. vol. i.

the brain, that very important advantages often result from them. By lessening the pain, and removing that restless state of anxiety that commonly prevails, they frequently prove more useful than any other remedy.

These are the means on which we chiefly rely ; but some attention is likewise necessary to the local treatment of the injured parts, from which more advantage I think may be derived than is commonly imagined.

Instances often occur of inflammation in other parts of the body being relieved by drains or issues ; and on the same principle I have long been in the habit of advising drains in inflammatory affections of the head.

With a view to this, when the teguments are divided, whatever the extent of the cut may be, as the lips of the sore are apt to become hard, dry, and painful, those applications should be advised which answer best in promoting the formation of matter : The sore should be covered with
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pledgets of lint spread with any emollient ointment, and warm emollient poultices should be laid over the whole. In this manner, and particularly by a frequent renewal of poultices, a plentiful discharge of matter is commonly induced ; which soon lessens the pain, and removes the hardness of the injured parts, by which all the other symptoms soon become moderate.

Where again the teguments are not divided, as soon as there is cause to suspect, from the parts that were injured becoming pained and swelled at the distance of several days perhaps from the accident, that bad symptoms may supervene, the tumor should be immediately laid open, by dividing the skin and teguments down to the pericranium ; and if that membrane is found to be separated and raised from the bone, it ought also to be laid open : By this means any matter that is confined, and which otherwise might have done harm, will be discharged ; and by inducing a suppuration upon the sore, in the

manner I have mentioned, all the symptoms will be kept moderate.

In the treatment of these tumors, they are seldom opened till a fluctuation is distinctly perceived in them. In this, however, I think we are wrong; for the matter that tumors of this kind contains is constantly thin and acrid; so that to confine it in contact with the skull, must not only render the bone liable to become carious, but must even incur some hazard of making the inflammation spread to the membranes of the brain: for, as an intimate connection takes place between the vessels of the pericranium and dura mater; and as it is evident in this kind of injury, where the external parts are first hurt, that the dura mater becomes inflamed only in consequence of its connection with these, I have long thought it probable, that the confinement of acrid matter beneath the pericranium, is to be considered as the most frequent cause of the inflammation being communicated to the parts within the skull: I have accordingly been
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in the habit of discharging it by a free incision, as soon as the least tumefaction on the part affected is perceived; and evidently with much advantage.

In all injuries indeed done to the head, in which the symptoms do not commence till several days after the accident, as the inflammation does not originally attack either the brain or its membranes, for if it did so, its effects would be immediate, it is probable that it acts almost solely by producing an effusion between the pericranium and skull: And as we know that membranous parts seldom or never afford good pus, any effusion which takes place must commonly be of a nature that will not readily become purulent, and will therefore be apt to acquire that kind of acrimony commonly met with in every extravasated fluid that cannot be converted into pus.

Where the effusion is considerable, an evident tumefaction takes place from the beginning: But it often happens, that it is so small in quantity as scarcely to pro-

duce any perceptible swelling at first ; in which case, as there is little or no tension, the patient feels little uneasiness till the effused fluid begins to turn acrid, which may happen sooner or later according to the violence of the injury, and habit of body of the patient, as well as other circumstances. But as soon as it becomes acrid, it excites pain, inflammation, and swelling ; and as the pericranium and aponeurotic expansions of the muscles are very firm and strong, if this acrid matter be not soon discharged by an incision, it gradually insinuates between those parts of the pericranium and bone beneath that were not at first affected : And as this extends the effects of the injury, it not only tends to increase the tumor of the integuments, but, by means of the vascular connection that I have mentioned between the pericranium and dura mater, the inflammation is at last conveyed to the parts within the skull ; and as soon as these inflame, but never till then, the bad symptoms are sure to take place.

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It is therefore probable that the confinement of this acrid matter beneath the pericranium, must have no small effect in promoting the progress of the inflammation; and hence, to discharge it by an incision is always advisable whenever there is cause to suspect, from the accession of pain and some degree of tumefaction as the consequences of external violence, that matter is collected even in the smallest quantity between this membrane and the skull.

It must be remarked, however, that I do not wish to recommend this practice in the treatment of tumors recently produced by external violence. It often happens, that a tumor of a considerable size succeeds instantly to a blow on any part of the head; but in general this soon disappears on the application of mild astringents, such as solutions of crude sal ammoniac, white vitriol, or saccharum saturni: Ardent spirits make also a good application for these tumors, and they seldom fail to remove them.

It would therefore be improper in all such cases to lay the injured parts open ; a practice, however, often adopted by those who are not versant in this branch of business ; for, as this kind of tumor frequently affords, to manual examination, a sensation similar to what is experienced from a depression of the skull, young practitioners are very apt to be deceived with it, and to advise the skull to be immediately laid bare. But no practitioner of experience will ever be deceived with these appearances ; nor will he ever proceed to lay the skull bare, if more evident marks do not take place of its being injured, or of matter being extravasated beneath the skull itself. But whenever a tumor attended with pain, appears at a distant period upon the spot on which a blow or a bruise was received, as it seldom or never happens that swellings of this kind are of a harmless nature, or that they can be dissipated by external applications, they should in every instance be laid open as soon as they become perceptible. By doing so, we can
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never do harm; while we always derive advantage from discharging acrid matter, which in circumstances such as we are considering, is almost always collected beneath the pericranium.

An incision made for discharging matter, must necessarily go to the depth at which the matter is seated; otherwise the purpose for which it is meant will not be answered: And as in the circumstances now under consideration, it is almost in every instance collected beneath the pericranium, this membrane should always be freely divided. But in making scarifications in the manner I have advised above, for the purpose of discharging blood, as they are supposed to be necessary before any tumor has appeared, and not intended for the evacuation of matter, they need never be carried to such a depth. They should pass indeed freely into the cellular membrane, otherwise the arteries of the part will not be sufficiently divided; but as no advantage could be derived in this state of the disease from dividing the pericranium,

pericranium, and as the bone might be hurt by it, it ought never to be advised.

The wound produced by the incision, should be dressed with any emollient ointment; and by the frequent renewal of warm poultices over the whole, a plentiful suppuration will be induced, which, as I have already remarked, proves commonly very effectual, not only for preventing, but removing all those bad symptoms which inflammation of these parts is sure to induce.

When, however, the inflammatory state of the brain does not yield to this treatment; when the symptoms become more violent, and are succeeded by paralysis, irregular convulsive motions, involuntary passage of the fæces and urine, dilatation of the pupils, and insensibility to the impression of light, along with a slow and full pulse; and more especially when these symptoms have been preceded by fits of rigor or shivering; we conclude, that the suppurative state of the disease has taken place;

place; that matter is formed within the skull, and operates by compressing the brain.—Shivering fits take place on the formation of large abscesses wherever they are seated; but in inflammatory affections of the brain, they prove so certainly characteristic of suppuration, that no doubt can remain of matter having formed, whenever they are found to accompany the other symptoms that I have mentioned.

The existence of matter within the cranium being ascertained, as we cannot depend on any other means for carrying it off, the trepan should be immediately advised; and as the safety of the patient is to rest entirely on a free discharge being given to the matter, it should be applied with much freedom. In such circumstances, indeed, it would be very culpable timidity in any practitioner to hesitate in forming as many perforations as are necessary for discharging the matter.

When, on perforating the skull, no matter is met with, if the dura mater appears

pears to be more tense than usual, as this will give cause to suspect that the symptoms of suppuration have arisen from matter collected between this membrane and the pia mater, or perhaps upon the brain itself, we ought not to rest satisfied with having merely perforated the bone: If in such circumstances we proceed no further, the matter will still remain confined; the brain will be nearly as much compressed as before; and of course no advantage will be derived from the operation.

In this situation, therefore, a practitioner should not hesitate in dividing the membranes of the brain. But, for the method of effecting this, as well as for some further observations which relate to it, I must refer to the second section of this chapter, where the subject has been fully considered.

When, again, it is found on perforating the skull, that the dura mater has become sloughy, with some tendency to gangrene, the utmost danger is to be dreaded: If mortification has commenced, death will
soon

soon probably terminate the scene, although instances have occasionally occurred of sloughs forming upon the dura mater, and of cures being accomplished after these have separated : All, however, that art should in such cases attempt, is to preserve the fores clean ; to see that any matter which may form shall be freely discharged ; to take care that nothing but light easy dressings shall be employed ; and that Peruvian bark, conjoined with elixir of vitriol, shall be immediately given in as great quantities as the stomach will bear. If any tendency to inflammation still prevails, the diet should be low, with a plentiful allowance of whey and other diluents, and regular stools should be procured : But, when the system is low and the pulse feeble, wine should be exhibited as the most effectual cordial. In other respects, the treatment should be such as proves most beneficial in similar affections of other parts of the body ; but as this has already been fully taken notice of

of in a preceding chapter, it is not necessary to enter upon it again *.

Before leaving the subject that we are now considering, I think it right to notice a practice that has prevailed in the treatment of this kind of injury, which ought in my opinion to be laid aside; namely, the indiscriminate use of the trepan in the inflammatory as well as in the purulent or suppurative stage of these symptoms. It has been common, in all cases of this kind, in the first place to prescribe large evacuations; and if these do not procure relief, to apply the trepan immediately, whatever may be the stage of the disease.

This practice is chiefly founded on an idea that has prevailed with some, of the operation of the trepan being an innocent remedy, and of no harm being ever produced by it. In support of this opinion, experiments are related of the operation having been performed in sound animals, with a view to determine the question, Whether exposure of the brain to the air
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* *Vide* Treatise on Ulcers.

is detrimental or not? And as it has happened in several instances, that no bad effects have ensued, a general conclusion has been drawn in favour of the operation.

But were we for a moment disposed to admit the truth of this conclusion, yet one great objection to the application of the trepan in an inflamed state of the brain, would occur,—that no benefit could be derived from it. The sole object we should ever have in view from this operation, is to remove pressure from the brain: But in an inflamed state of this organ, as no pressure is supposed to exist, the remedy is of course unnecessary.

If practitioners would allow themselves to be directed by the effects of those remedies that prove useful in similar affections of other parts of the body, inflammation of the brain would never be treated in this manner: We need not surely expect to derive advantage from perforating the chest in the first stage of an inflammatory affection of the pleura; nor
would

would any surgeon advise it till the formation of matter was fully indicated.

Besides this, however, I am decidedly of opinion, that the trepan cannot be applied in inflammation of the brain, but with manifest hazard: It tends always to increase the symptoms of inflammation; and in almost every instance in which I have known it employed during this state of the disease, the dura mater has been found, after death, either in a state of mortification, or covered with purulent matter.—These effects we may suppose to be in some measure the consequence of admission of air to the brain; and they may be partly owing to the violent separation of a portion of the cranium from the inflamed dura mater, to which it adheres firmly in almost every point.

Neither is this the only ground on which I would object to the practice: Contrary to the received opinion, I think that the operation of the trepan is in itself dangerous even when performed in a sound state of the brain, where no inflammation

mation takes place.—Several years ago I made a variety of trials to determine this point; and nearly one-fourth of the animals that underwent the operation, appeared to die from the effects of it.

It is not, however, from the effects of this operation on other animals alone, that I wish to draw any conclusion; but when consequences similar to what I have stated, result from it when performed on the human body, when no immediate injury has been done to the head, they will be allowed to have much weight in establishing the opinion I have advanced.—I have accidentally met with three cases much in point, in none of which there was any appearance of inflammation of the brain previous to the operation; and yet, two of the patients died in a few days after the perforation of the skull, evidently from inflammation induced upon the dura mater. As cases of this kind do not often occur, and as the result of these tends to establish the validity of the opinion I have advanced, I shall here give a short account of them.

In cases of inveterate epilepsy, where every other means of relief have failed, it has been proposed, to admit the free pressure of the atmosphere to the surface of the brain, by one or more perforations made in the skull with the trepan. Any advantage to be obtained from this, I must acknowledge to be extremely doubtful; and the effects of it appear to me to be so uncertain, and even hazardous, that I should never think of advising it. But it has so happened, that I have known two instances of its being done by others; and in a third, I had occasion to put it in practice myself, in the case of a gentleman who had laboured under epilepsy for upwards of twenty years. But in this case, as the fits appeared to be the consequence of an injury received in childhood upon the forehead; as the external appearance of the part on which the injury was inflicted, gave cause to suspect that a small portion of the skull was depressed at this place; as there was
some

some reason, therefore, to suppose, that the fits depended upon this cause, and as they were at this time become extremely violent, it was the opinion of several practitioners of this place, as well as the earnest desire of the patient, that the trepan should be employed. This was accordingly done; the portion of the skull which received the blow was taken out; and matters went on very favourably till the end of the second day from the operation, when symptoms of inflammation occurred; and, notwithstanding all the remedies that were employed, he died in little more than forty-eight hours from this period. On opening the head, a great quantity of pus was found, not only on the dura mater, but on the pia mater, and even between this membrane and the brain; and as there was not, till within twenty-four hours of his death, any symptoms of a compressed brain, there is much reason to think that the matter was formed merely in consequence of inflammation induced by the operation; and therefore, that the means

employed for the patient's relief had evidently hastened his death.

One of the others on whom the operation was performed, recovered from the immediate effects of it, but with no alteration or abatement of the fits for which it was employed. The other died on the seventh day from the operation: Symptoms of inflammation appeared on the third; and these were at last succeeded by evident marks of a compressed brain: A considerable quantity of matter was found between the dura and pia mater, and even beneath this membrane, not merely on the parts contiguous to the wound, but over the whole surface of the brain.

We have here two cases, very distinctly marked, of the hurtful effects of this operation, even in a sound state of the brain, at least where no previous inflammation appeared to exist in it. The symptoms of inflammation which supervened in both instances, were evidently the effect of the perforations: Suppuration ensued in both; and

and as both the patients died in the space of a few days from this period, no doubt can be entertained of the cause of it.

I am therefore induced to consider the operation of the trepan as inexpedient, and even dangerous, in an inflamed state of the brain: But when suppuration has taken place, and when matter formed within the skull operates as a cause of compression, as this operation affords the only chance of safety, it should be employed with freedom, and without hesitation. —We proceed now to the consideration of Fissures, or simple Fractures of the Skull.

§ 2. *Of Fissures, or simple Fractures of the Skull.*

THE term Fissure is here meant to imply a mere division or simple fracture of the skull not attended with depression; and it may either penetrate the whole thickness of the bone, or be confined to

one lamella of it only : A fissure may also be attended with a division or wound of the corresponding teguments, or these may be left entire.

I have already had occasion to remark, that injuries done to the head, prove hazardous nearly in proportion to the violence which the brain receives from them: So that fissures, in so far as they affect the skull only, are not to be considered as dangerous ; but being frequently combined with affections of the brain from the beginning, and on other occasions productive of consequences from which this organ is ultimately brought to suffer, they of course require our most serious attention. It often indeed happens, that very extensive fissures heal without any bad symptom taking place ; but as others which are apparently trivial, frequently terminate in the most fatal manner, we cannot with propriety in any instance treat them with neglect.

Fissures of the skull may prove dangerous, either from being productive of effusions

effusions of blood or serum upon the brain, or by tending to excite inflammation of the dura and pia mater.

When effusions take place, as this must be attended with symptoms of compression, those means should be advised that are known to be best suited for its removal; but as these have been already fully treated of in the preceding sections, it is not necessary to enter into a further detail of them: I shall just shortly observe, that for the removal of these effusions, we have to trust entirely to a proper application of the trepan. The fissures should be traced through their whole extent; and a perforation being made in the most depending part of each of them, if this does not prove sufficient, the operation should be repeated along the course of the fractures, as long as any symptoms continue of a compressed state of the brain; care being always taken to include the fissure in every perforation: For, as the cause of the mischief will in general be found contiguous to the fracture, it would seldom answer any good

purpose to perforate the skull in any other part.

It is therefore scarcely necessary to observe, that care should be taken to trace the course of the fissures with much accuracy; for which purpose, as soon as we resolve on performing the operation, if the whole extent of the fracture has not been previously discovered, it should now be done by making an incision through the skin and other teguments down to the pericranium: and by taking care to follow the direction of the fissures, they may thus be brought freely in view.

When fissures are of such magnitude as to produce an obvious separation of the two sides of a fractured bone, the nature of the case at once becomes obvious; but it often happens, that they are so small as to render the operator doubtful and uncertain. A little attention, however, to the real state of the patient, will at all times prevent any hesitation respecting the means that we should employ.

The only appearances with which a fissure is in danger of being confounded,
are,

are, those indentations formed on the external surface of some parts of the skull by the blood-vessels which run upon it; and the different futures which serve to unite the bones of the skull together.

In doubtful cases of fissure, we may frequently be determined by the degree of adhesion that takes place between the pericranium and skull. The pericranium, as we have seen, naturally adheres firmly to every part of the skull, and particularly at the futures; and as one certain effect of a fissure is to destroy this connection entirely, when the pericranium adheres to the bone beneath, we may conclude without hesitation, that no fissure exists; and, on the contrary, when this membrane is loose and somewhat separated from the bone, there will be much reason to suppose that any rent or crack that appears in it, is produced by a fracture.

It often happens, however, that we are deprived of this means of detecting fissures, by the pericranium and other teguments being separated from the bone for a considerable

considerable space. In this situation, various means have been proposed for obtaining a certainty of the nature of the case. By pouring ink over the surface of the denuded bone, the whole of it, we are told, may be wiped off, if the bone is not fractured; but, wherever there is a crack or fissure, that it will be impossible even with the assistance of water to remove it.

By making the patient keep a firm hold with his teeth of one end of a hair, or of a piece of catgut, while the other extremity is secured at such a distance as to render it tense, if it is now struck, the vibrations thus produced will create, we are told, a very sensible degree of uneasiness in the part affected, if it is fractured; but will not otherwise have any effect. And again it is said, if the patient is made to chew a bit of bread, or any other hard substance, that some pain will occur from it if the bone is fractured; but otherwise, that the injured part will not suffer.

None of these tests, however, are to be much depended on: neither of the two
last

last have any effect, unless the fissure is extensive, and the sides of the fractured bone considerably separated from each other, when this means of distinction can never be necessary ; and as ink penetrates the sutures of the skull, unless when they are firmly ossified, it can seldom happen that any trial to be made with it will be productive of any advantage.

It commonly happens, in fissures extending through the whole substance of the skull, and even in such as penetrate only to the diploë, that blood continues to ooze from them for a long time after the accident, and it constantly returns again almost as soon as it is wiped off: This is one of the most characteristic marks of a fissure, and it points out with precision the nature of the case. But there is no necessity, I may remark, for so much anxiety on this point as practitioners commonly express ; for, unless when symptoms of an alarming nature take place, I shall presently endeavour to show that no operation should be advised : And again,
whenever

whenever the symptoms indicate a compressed state of the brain, if any appearances of a fissure are dreaded in that part of the skull which has recently received a blow; however equivocal they may be, yet as this is most probably the seat of the injury, no doubt should be entertained of the propriety of perforating the skull at this place. If it should afterwards appear that the trepan has been applied upon a future, as the surgeon under such uncertainty would proceed with much caution, no harm could ensue from it; and if it should prove to be a fracture, it would afford him much satisfaction to find that the perforation had been made where alone it could prove useful.

But although I have in this place, as well as in other parts of these observations, advised the trepan as the only remedy to be trusted for the removal of symptoms of a compressed brain; yet unless where symptoms of this kind take place, even the presence of a fissure ought not to indicate the operation: But as this
is

is a point upon which I happen to differ from many of the profession; and as it is of much practical importance to have it duly considered; I shall advert to it with more minuteness, than might be otherwise necessary.

Hitherto it has been a general rule, to consider the application of the trepan as necessary in every fissure, whether any symptoms of a compressed brain have occurred or not. But due attention to the real nature of a fissure, and to the effects most likely to result from perforating the skull, will show, that although fissures may be frequently combined with such symptoms as require the trepan, yet that they are not always or necessarily so; and unless when such symptoms actually exist, that this operation, instead of affording relief, must frequently do harm: for it is by no means calculated for, or in any respect adequate to, the prevention of these symptoms; and I have already endeavoured to show, that laying the brain bare is never to be considered as harmless; and
therefore

therefore that it should never be advised but when it is probable that some advantage may be derived from it.

When a fissure is attended with a compressed state of the brain, there can be no hesitation, as I have observed already, in recommending an immediate application of the trepan: But in the case of a fissure not accompanied with any symptom of this kind, and while the patient complains of nothing but perhaps a slight degree of pain in the contused part, an occurrence by no means unfrequent; what advantages are we to expect from perforating the skull? In this situation, we know, that no extravasation takes place; and that no part of the skull is depressed, otherwise symptoms would occur of a compressed state of the brain: For what purpose, therefore, should the trepan be applied? No sufficient reason, I believe, can be adduced for it.

In the case of a simple fissure, not attended with any bad symptoms, the most alarming occurrence that we have to
dread

dread is the accession of inflammation; for it frequently happens, that the membranes of the brain become afterwards inflamed, although the patient may have remained perfectly well for several days, nay, even for weeks, after the injury producing the fracture was inflicted. Now, whoever attends to one of the immediate effects of the trepan, namely, the violence done by it to the dura mater, together with the admission of air to the parts within the skull, must acknowledge, that this tendency to inflammation, the circumstance which, of all others, we have most cause to dread, instead of being lessened by this operation, must, in all probability, be increased; so that, as a preventative of bad symptoms, it ought never to be advised.—It has, indeed, been keenly held forth by those who support a contrary opinion, that, in fissures of the skull, no additional risk can be incurred by this operation; for it is said, that air being already admitted to the brain by the fracture itself, the trepan will not give it

a more free access, while at the same time, they observe, that it is attended with the very important advantage of forming and preserving a free vent for any matter that may form between the skull and dura mater during the cure.

This argument is specious, but it will not on examination be found to merit attention. For, when fissures are so extensive as to produce any obvious separation between the sides of the fractured bone, a more sufficient vent is thus procured for any matter that may form than could possibly be obtained by an operation: And again, in fissures of lesser extent, as they do not always terminate in the formation of matter beneath the skull, but, on the contrary, as they frequently do well without the occurrence of any bad symptom, it cannot surely be considered as prudent to advise a hazardous operation, merely for the chance of its becoming necessary. And besides, instances are often met with, in which fissures penetrate no deeper than the external table
of

of the skull; a circumstance which cannot be previously known; and for which even the warmest supporters of the practice in question would never surely recommend a perforation through the whole substance of the bone.

The idea that has hitherto very universally prevailed, of the harmless nature of this operation, has probably been the chief cause of the opinion respecting the propriety of performing it in every case of fissure: But, if the opinion that I have given is well founded, any utility probably to be derived from it, will be more than counterbalanced by the hazard with which we suppose it to be at all times attended.

Whilst no bad symptoms supervene, a fissure of the skull should be treated, merely as a cause that may give rise to inflammation. The patient should lose blood once and again, in proportion to his strength; his bowels should be kept open; the fore should be treated with mild dressings; and as long as there is cause to

suspect that inflammation may occur, violent exertion of every kind should be avoided: For although, in such circumstances, I would not, for the reasons that I have given, advise the common practice of perforating the skull in every case of fissure, I am perfectly decided in this, that fissures should always be treated with attention, and should have the most effectual means employed for obviating those effects that arise from them when inflammation takes place.

By the means that I have pointed out, a cure will frequently be obtained, without putting the patient to the hazard arising from the operation of the trepan; but when, from the violence of the injury, or from any other cause, they are found to fail, and that the inflammation terminates in suppuration, as in such circumstances nothing but a free discharge to the matter can save the patient, this operation will now with much propriety be employed: But, for the reasons I have already advanced, I must again say, that till this stage of the disease

disease takes place, the perforation of the skull ought never to be advised. The arguments adduced in support of this opinion in different parts of this and the preceding sections are perhaps of themselves satisfactory; but in a point of such importance, no person should speak decisively on any opinion not supported by experience. When the result of experience, however, is supported by probability, we more readily give our assent to it than could ever be done to a mere practical fact; and as all the observation I have been able to make respecting the point we are speaking of, tends to support the practice that I have advised, it is without hesitation that I venture to propose it.

SECTION VI.

Conclusion.

THE importance of the subject that we have just been considering, together with the intricacy in which it is involved, has led to a length of discussion which I did not at first expect: If, however, in treating of injuries done to the head, I have in any degree contributed to remove the perplexity that has hitherto obscured the subject, arising, as well from the complicated nature of the injuries themselves, as from the manner in which authors have generally handled them; the time I have spent, and the pains I have taken, will not be thought misapplied.

The length to which this chapter has extended, points out the propriety of
bringing

bringing the more material parts of the subject into one point of view: On this account, the following recapitulation is subjoined.

1. It appears, that in a state of health, the cavity formed by the bones of the skull is completely filled with the brain and its membranes.

2. That a direct communication takes place between the external coverings of the skull and the parts contained within it, by means of blood-vessels passing between the dura mater and the pericranium, especially at the different futures.

3. From this mechanism, we may perceive, how the smallest diminution of the cavity of the skull, however it is produced, must always occasion compression of the brain: And from it also we account for the ready communication of inflammation from the external teguments of the skull to the dura mater.

4. The various symptoms arising from injuries done to the head, may be refer-

red to three general effects ; compression, concussion, and inflammation of the brain.

5. In a compressed state of the brain, the safety of the patient depends solely upon the removal of the cause by which the compression is produced. When a portion of the bone is beat in, and is at the same time so loose as to admit of its being taken out with the fingers of the operator, with common forceps, or perhaps a levator, these only should be employed : But when the depressed portion of bone is firmly fixed, or when the compression is produced by the effusion of blood, or formation pus, a proper application of the trepan can alone afford relief ; and we ought not to hesitate in employing it.

In such circumstances, the patient is in a very hazardous situation ; and perforating the skull with the trepan as frequently as may be necessary, may prove, as it often has done, a very effectual remedy.

6. We are by no means, however, to imagine, as many have done, that a surgeon

geon has accomplished all that may be proper for him to perform, on the operation being finished. Indeed, little advantage will in general be derived from it, if other circumstances are not kept in view. As the cause producing the compression, whatever it may be, must injure the membranes of the brain, care should be taken, as far as it can be done, to obviate the effects of it. No dossils, or syndons as they are termed, should be crammed into the perforations made by the trepan, and every irritating application should be avoided. The whole surface of the sore should be lightly covered with soft lint spread with any emollient ointment; and this, with a compress of soft linen, should be retained by a common night-cap, as the easiest and best bandage that can be applied to the head. The patient should lose blood in proportion to his strength; his bowels should be kept open; his skin should be preserved soft and perspirable; a low diet should be recommended; and he

should be kept free from noise and every kind of disturbance.

7. When symptoms arising from external violence done to the head, depend on concussion or commotion of the brain; as this seems to operate chiefly by inducing debility of the whole system, the common practice of discharging much blood, and giving strong purgatives, should be avoided.

Instead of this, a moderate use of wine, as well as other cordials, should be advised, together with a nourishing diet; whilst blisters and other stimulants should be applied to the head itself. In long continued affections proceeding from this cause, such as loss of memory and imbecility, electricity may be safely employed. I have known some instances where it appeared to prove useful.

8. In the treatment of injuries done to the head, it should always be kept in view, that inflammation of the membranes of the brain very seldom takes place immediately, but is apt to supervene at some distant period

period from the injury being received: In consequence of which, accidents which do not at first appear to be of much importance, frequently terminate fatally at last.

Where inflammation has taken place, we depend chiefly on general and local blood-letting, carried as far as the strength of the patient will permit. Strong purgatives should be advised: Sudorifics prove sometimes serviceable; and when the patient is restless, and distressed with violent pain, opiates frequently prove useful.

When an inflamed state of the brain succeeds to a contused wound of the external teguments, warm emollient poultices are the best applications we can make to the sore. By inducing a discharge of matter from the neighbourhood of the inflamed parts, they prove often highly serviceable; and, when the skin has not been divided by the contusion, it should be laid open upon the first appearance of a tumor, without expecting or waiting for a complete suppuration.

In

In recommending this treatment, I have departed from the common mode of practice, which directs the immediate application of the trepan if blood-letting and other evacuations do not afford speedy relief; and I have done so for two reasons.

In the real inflammatory state of the membranes of the brain, compression of that organ does not take place: It is not indicated by the symptoms which take place, nor is it met with on dissection in such patients as die in this stage of the disease: Perforating the skull therefore in this situation can do no good. And farther, the operation of the trepan in itself, is not, as is generally imagined, innocent and harmless. By admitting a free access of air to the membranes of the brain, it tends evidently to excite and promote inflammation in the parts beneath. Applied therefore in this case, the trepan may aggravate, but cannot relieve, the complaint for which it is used.

9. When, notwithstanding all our endeavours, the formation of pus takes place,
either

either upon the surface of the dura mater, or within this membrane, it falls in every respect to be treated as effusion induced in any other way. In this situation, the operation of the trepan is indispensably necessary; for by no other means can the matter be discharged, or the safety of the patient insured.

In performing this operation, instead of removing a considerable portion of the skin and other teguments, as has commonly been done, a simple incision upon the part in which the instrument is to be applied is all that is necessary; and no more of the pericranium should be removed than is required for this purpose.

10. During the progress of the cure, after the application of the trepan, fungous excrescences are apt to shoot out from the different perforations in the bone. There is seldom, however, any reason for our attempting to remove them, as is commonly done, by compression, caustic, or ligature; for in general they disappear soon after the ossifying process is completed in the several openings.

openings. But when this does not happen, and when they still continue to prove troublesome after the rest of the cure is accomplished, they may with safety be taken away, either with caustic or the scalpel.

In various points of importance treated of in this chapter, I have advanced opinions, and recommended modes of treatment, different from those which hitherto have prevailed: But however diffident I am in first dissenting from an established doctrine, if my own experience is found to justify this dissent, the more respectable the authority by which the contrary opinion is supported, the more investigation appears to me to be necessary.

But in proposing modes of practice different from what are sanctioned by long custom, I have never been conscious of being actuated by a spirit of innovation, or a desire of appearing singular: And whenever I have ventured to dissent from men of known abilities, I have always endeavoured, with fairness and candour, to
state

state the reasons of my doing so, and the grounds upon which my opinions are formed: At least this has been my intention, and I hope it will appear to others that I have done so.

END OF VOLUME THIRD.



PLATE II.

The figures in this Plate represent an apparatus for the cure of a rupture of the Tendo Achilles ; of which an explanation is given in Volume I. Chapter III. Section VII.

PLATE III.

Figs. 1. and 8.—Two forms of a tenaculum, for the purpose of pulling out blood-vessels to be tied with ligatures.

Figs. 2. and 4.—Two needles, somewhat different in the curve from those in common use : The handles being nearly straight, they are thereby managed with more ease than the others, particularly in deep wounds.

Figs. 3.

PLATE II.

Fig.1.

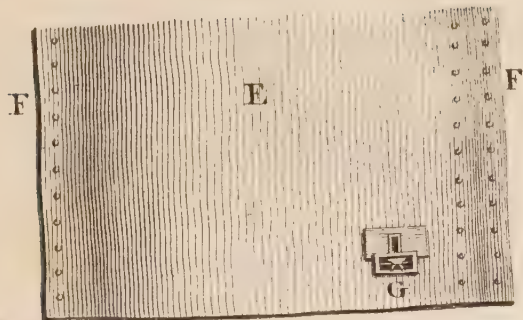


Fig.

3.

Fig.2.



Fig.

4.

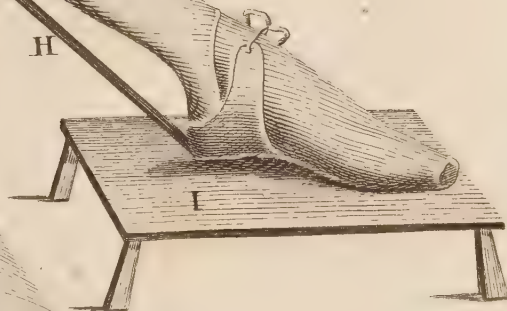


Fig.5.

Fig.6.

Fig.7.



Fig.8.

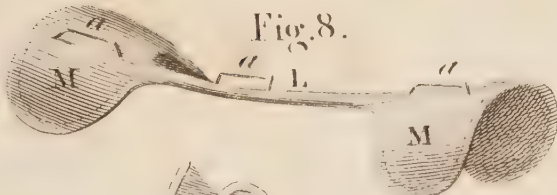


Fig.9.

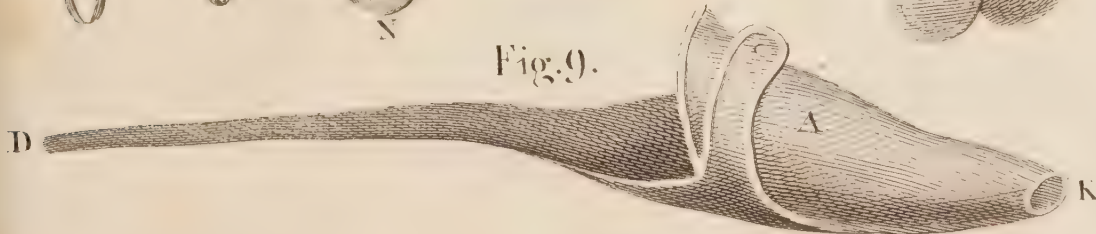


PLATE III.

Fig. 1.

Fig. 2.

Fig. 3.

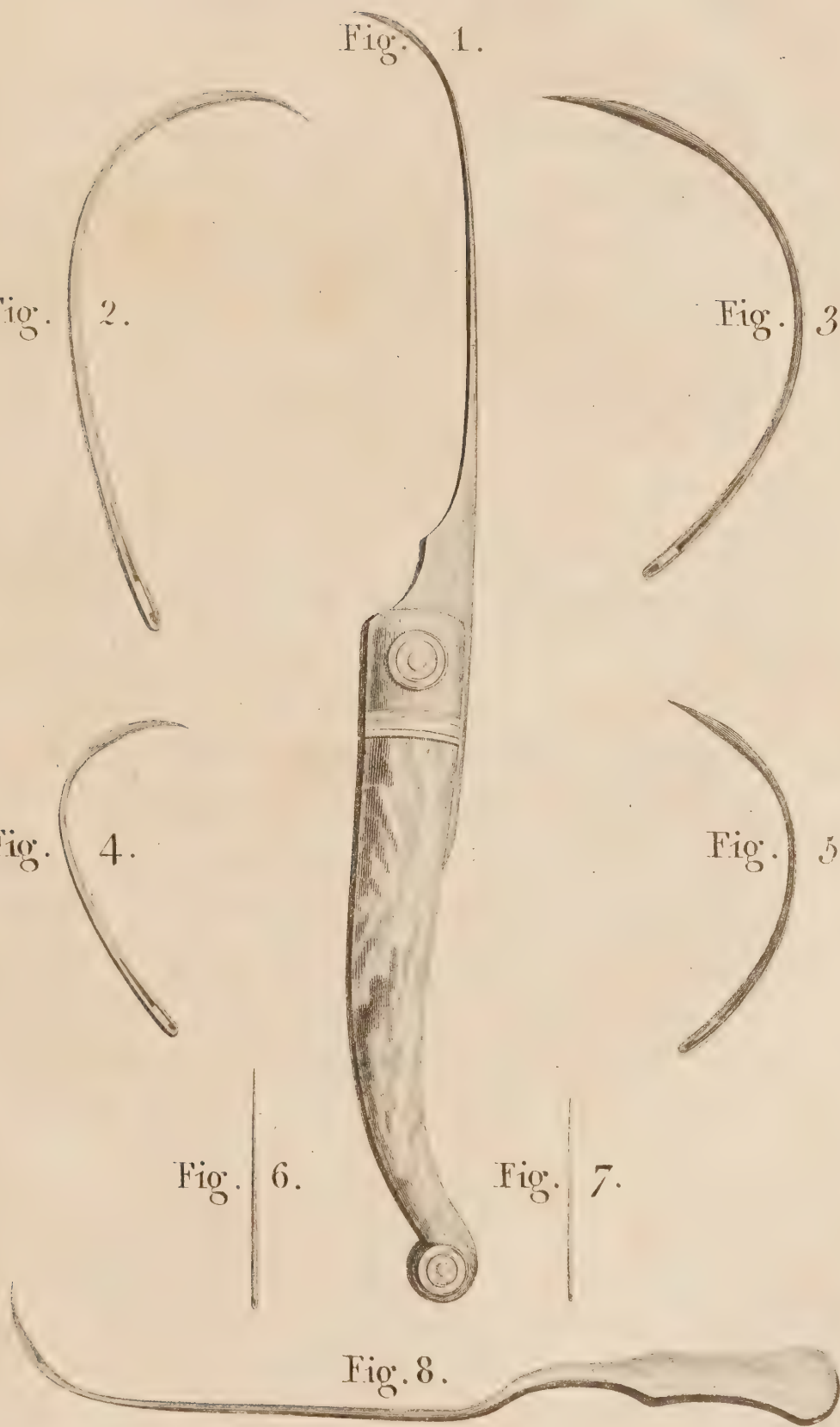
Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.



Figs. 3. and 5.—Two needles of the usual form, but neither these nor the other two have an edge on their concave parts. They are somewhat round like a lancet, both on their convex and concave sides; which adds to their strength, and makes them enter with more ease than the thick round form of the others.

Figs. 6. and 7.—Two straight needles for futures of the intestines, and other delicate parts.

Many instruments have been proposed for holding needles, when employed in deep wounds: The porte-aiguille, represented in Plate IV. fig. 1. answers this purpose as well as any other, but instruments of this kind are seldom needed. All these instruments are represented of a proper size for use.

PLATE IV.

Fig. 1.—A *Porte-aiguille*, mentioned in the explanation of Plate III.

Figs. 2. 3. and 4.—Gold pins, used in the twisted future, described in Volume III. Chapter VI. Section V.

Fig. 6.—A gold pin, with a steel-point, also used for the twisted future.

Fig. 7.—A moveable point of steel, fitted to the gold pin, fig. 8.

Fig. 5.—A flat needle, sometimes used in securing blood-vessels contiguous to bones.

All these instruments are here of a full size for use.

PLATE IV.

Fig.1.

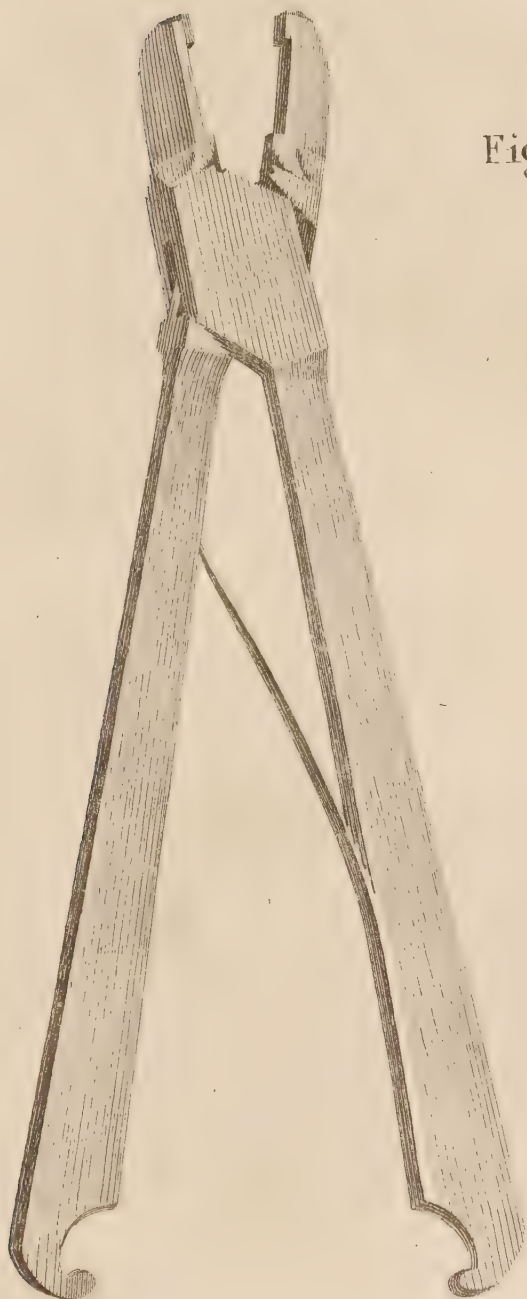


Fig. 2.



Fig. 3.



Fig. 4.



Fig. 5.

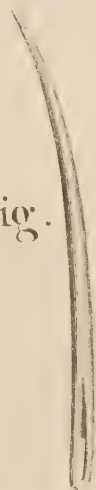


Fig.6.

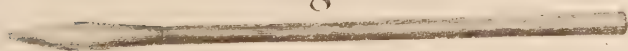


Fig.7.

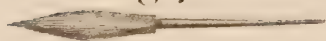


Fig.8.



PLATE V.

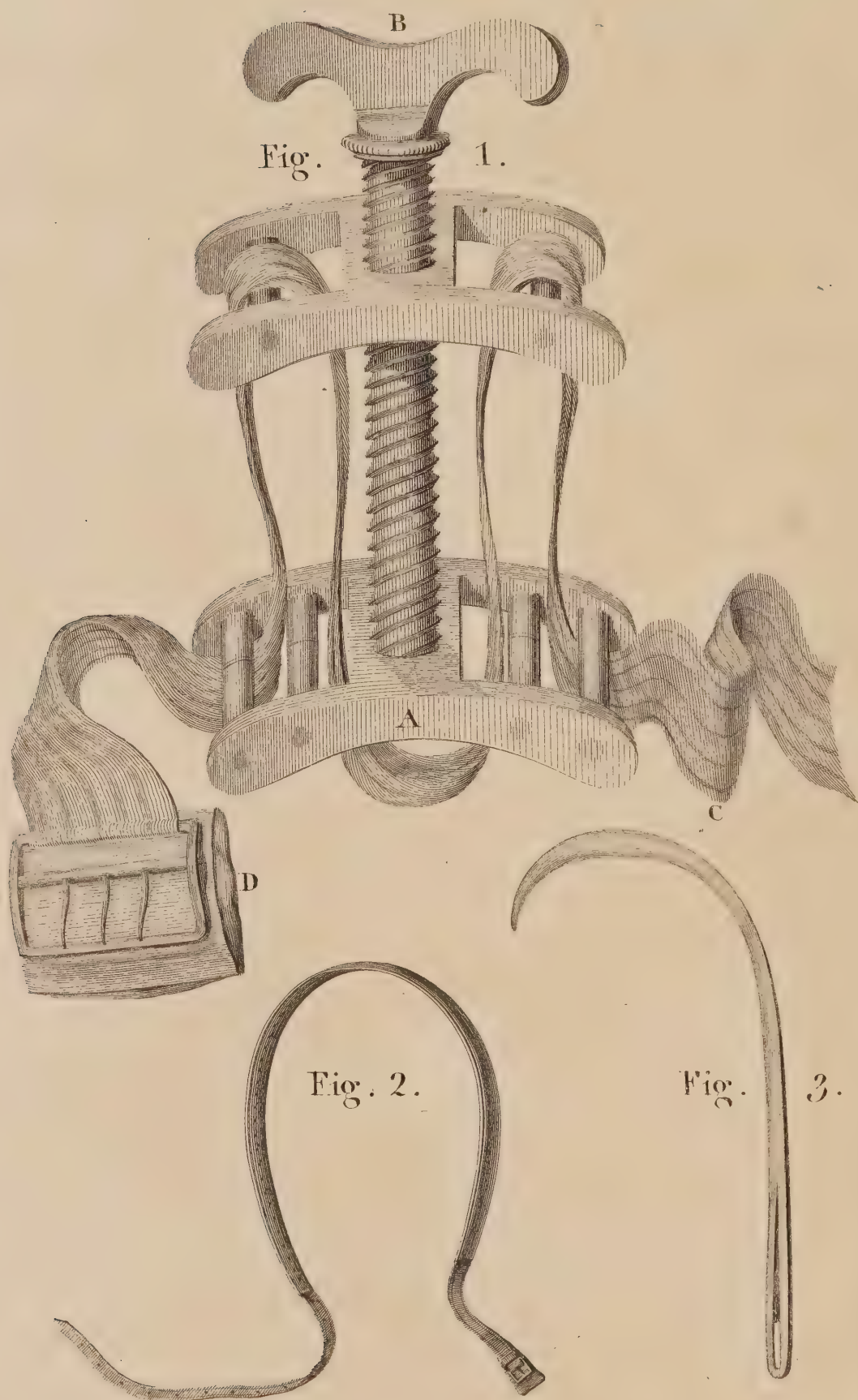


Fig. 2.

Fig. 3.

PLATE V.

Fig. 1. A screw tourniquet, described in Volume III. Chapter VII. Every part of this instrument is represented of the full size. It may either be made of brass or steel, and the strap should be of strong unyielding materials, at least an inch broad, and of a length sufficient to pass easily round the largest circumference of any of the extremities.

Fig. 2. A bandage for compressing the temporal artery. It is made of a well-tempered steel spring, covered with soft leather, and of the same strength with what is used for the truss of a hernia. It should be three quarters of an inch broad, and fourteen or fifteen inches in length. I once had a screw, fitted with a button to this bandage, the button, by

E e 2

means

means of the screw being made to press upon the divided artery; but a compress of linen answers better, and is easier for the patient. Bandages of linen, or other materials of a yielding nature, do not answer so well for this purpose as those of spring steel, which remain with more certainty on the spot on which they are first placed.

Fig. 3. A strong curved needle, with a round, though somewhat sharp point. This instrument answers the purpose better than any other yet proposed for passing ligatures below the artery in the operation for the aneurism, and beneath the spermatic cord in the operation of castration.

This instrument, as well as fig. 1. is represented of a full size for use.

PLATE VI.

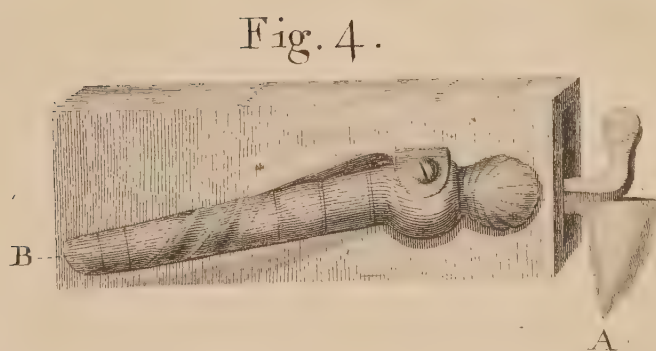
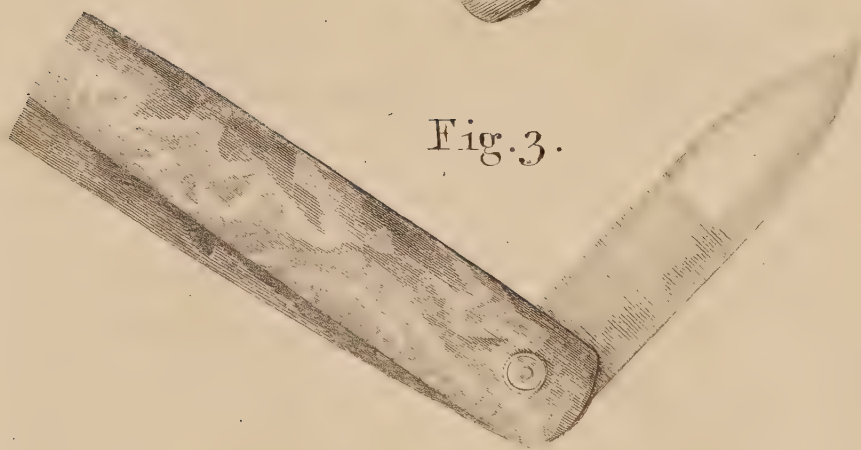
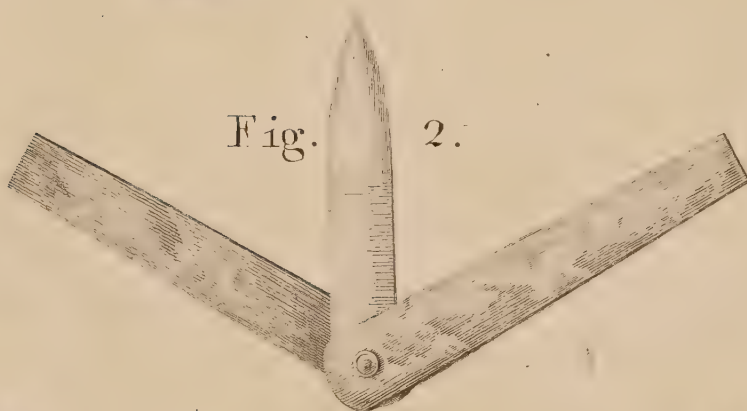
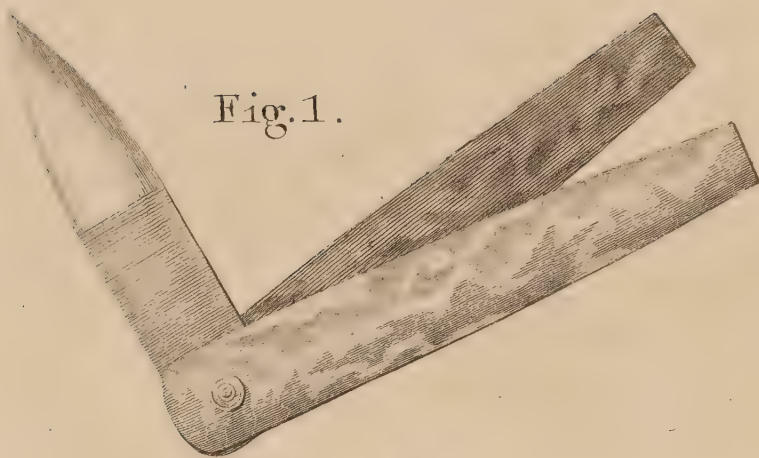


PLATE VI.

Figs. 1. and 2.—The best forms of lancets for the operation of blood-letting, described in Volume III. Chapter XIII. Section I.

Fig. 3. represents the broad-shouldered lancet in common use, but which, from its form, is evidently ill-suited for this nice operation.

Fig. 4.—A spring fleme, also described in Chapter XIII. Section I.

PLATE VII.

Fig. 1. A scarificator with sixteen lancets; the different parts of which are so generally well known, that it is not necessary to describe it.

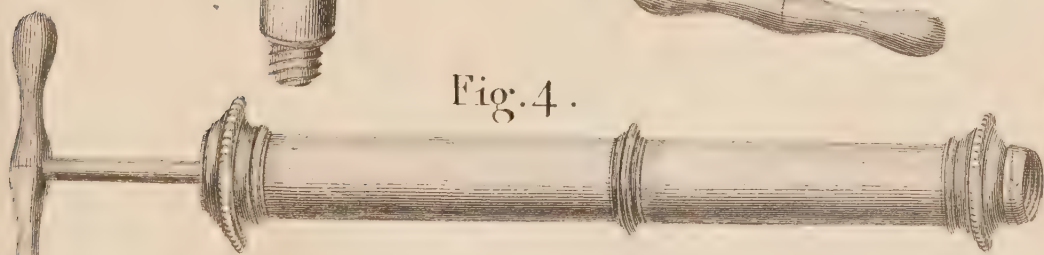
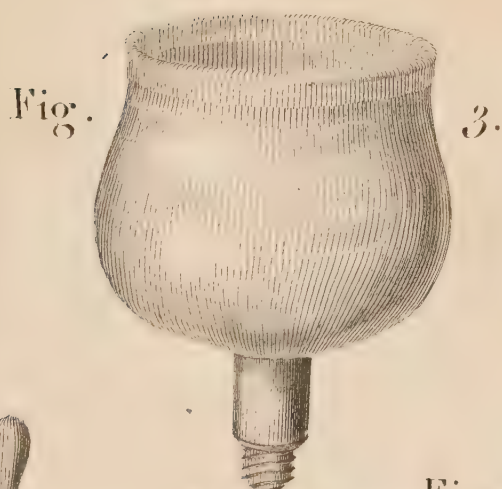
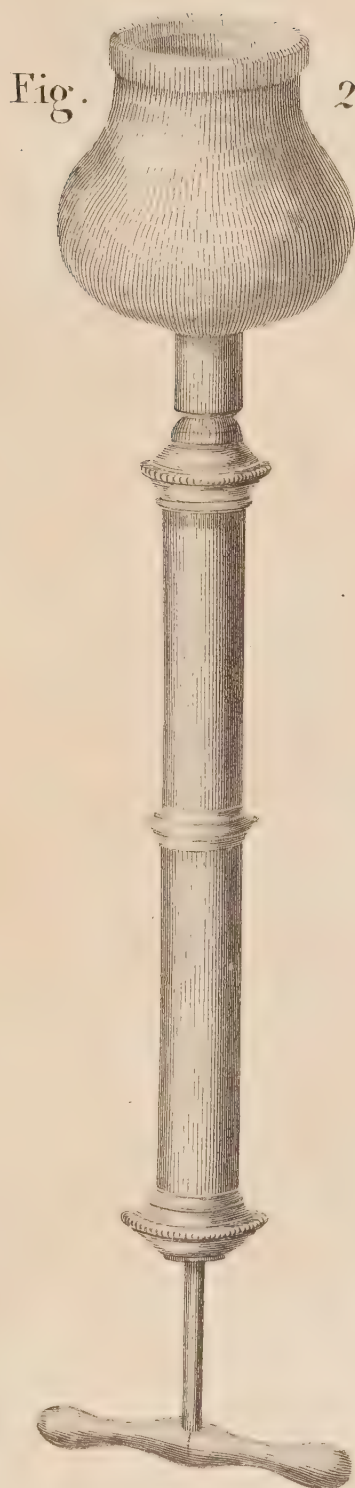
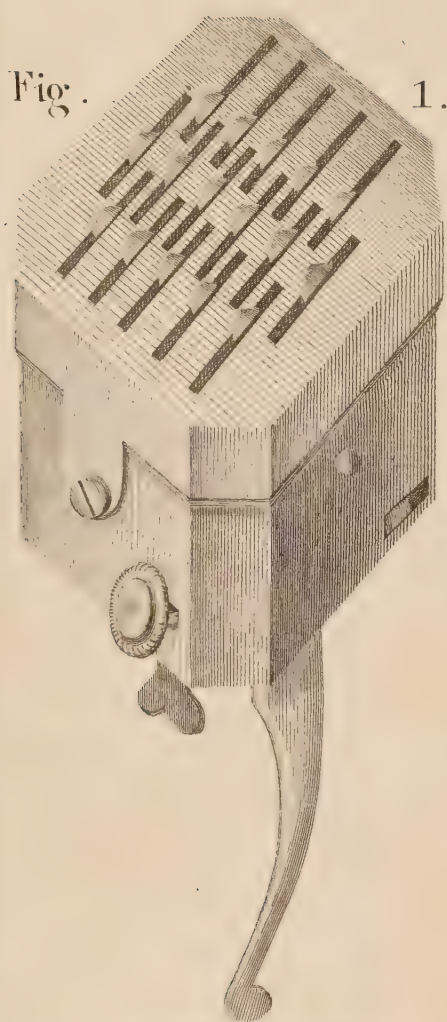
Fig. 2. A cupping glass, fitted with an exhausting syringe, for the purpose of extracting blood from wounds made by the scarificator, fig. 1.

Figs. 3. and 4. The different parts of fig. 2. represented separately.

PLATE VIII.

Fig. 1. This figure represents the instrument, commonly named a trepan. As
the

PLATE VII.



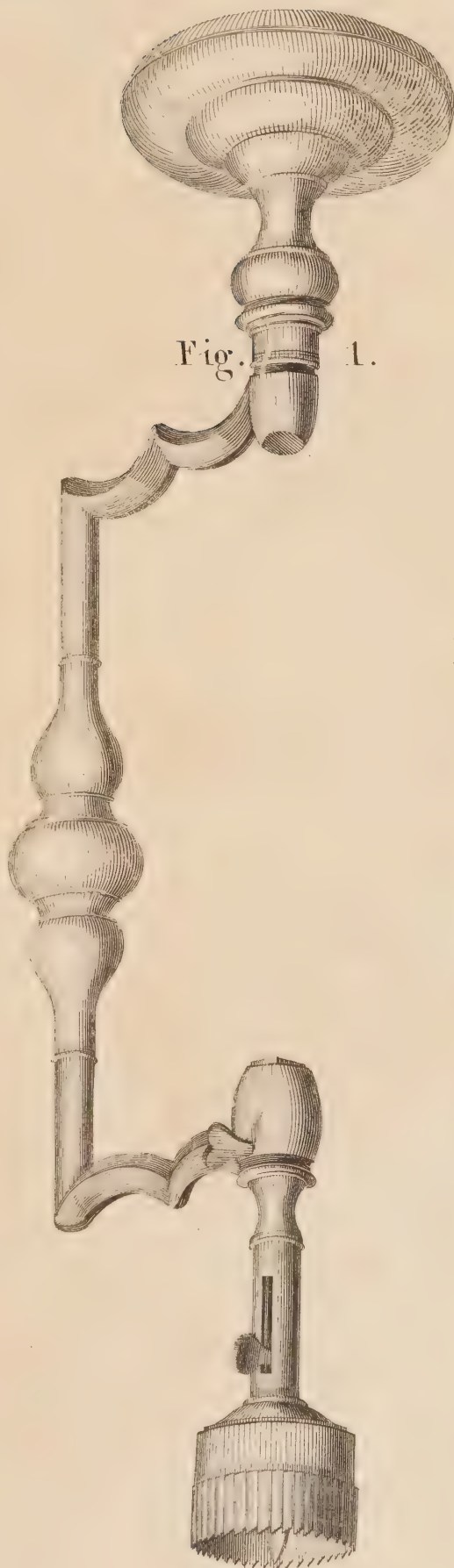


Fig. 1.



Fig. 2.

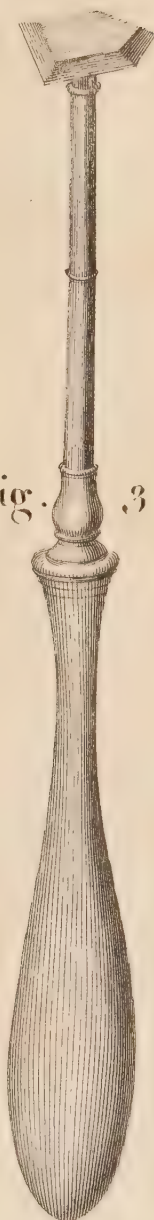


Fig. 3.



the page does not admit of the full size, every part of it is about one-third less than it ought to be. The upper part of the handle is of timber; the rest should all be polished steel.

For reasons that I have given in Chapter X. Volume III. every operator should be provided with this instrument as well as with the trephine, Plate IX. fig. 1. the same heads being made to fit both instruments.

Fig. 2. This instrument is commonly termed a lenticular. It is used by some for scraping the edges of the opening in the bone formed by the trepan, when they are found to be rough and unequal: For this purpose, it is sharp on one side, and the button on the top is meant to protect the brain, and to receive the pieces that fall from it. There is rarely, however, any cause for using it: I have never found it necessary, but I have given a view of it,

as it forms part of the apparatus of every surgeon for the operation of the trepan.

Fig. 3. A raspatory for removing the pericranium, before applying the trepan; but no more of the skull should ever be denuded than is merely necessary for the purpose.

PLATE IX.

Fig. 1. A representation of the trephine of a full size for use.

Fig. 2.—Forceps for the purpose of removing detached portions of a fractured skull. They are also used for taking out pieces of the skull that have been separated or cut out by the trephine, when they do not come away in the head of the instrument.

Fig. 3. A head of a trephine with larger teeth than the instrument in common use ;

PLATE IX.

Fig. 1.

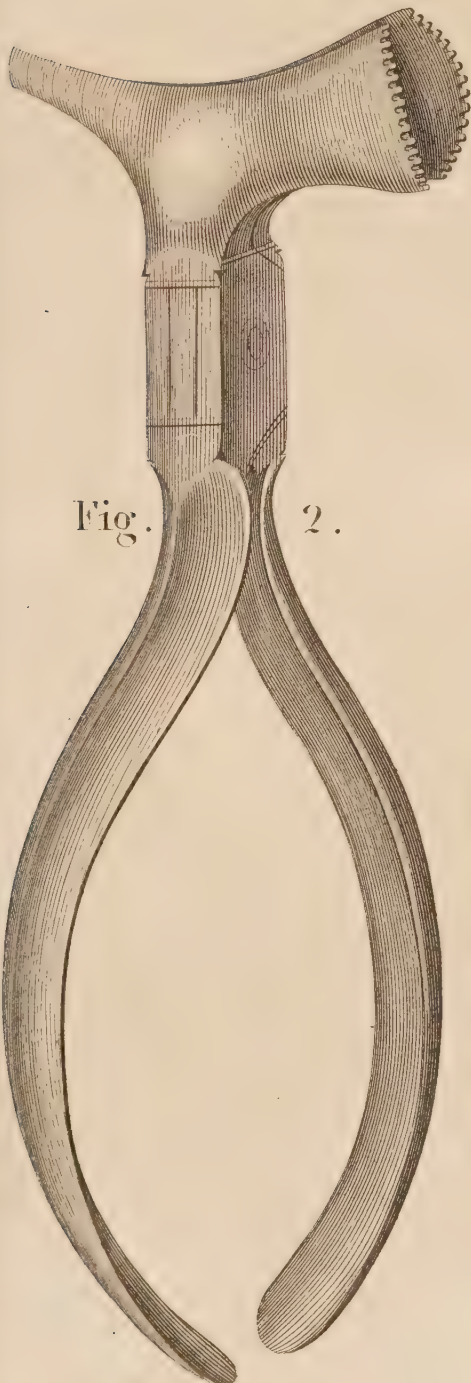
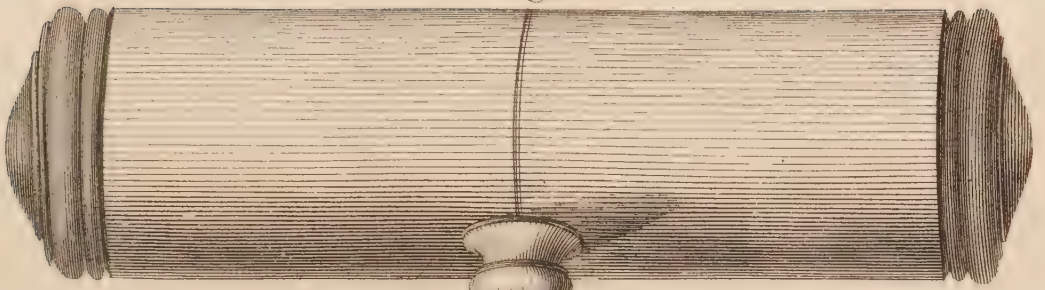


Fig.

2.

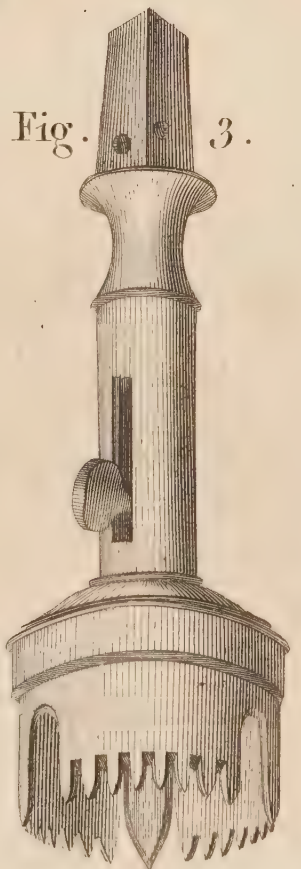
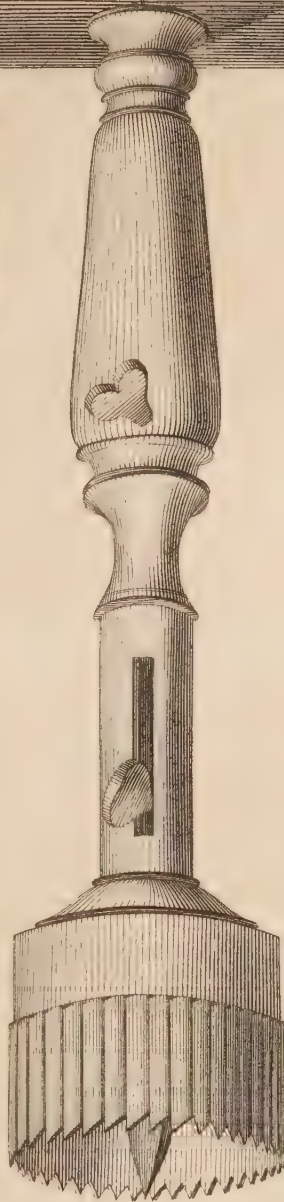


Fig.

3.

use ; and along the course of the saw, there are three vacuities in which the teeth are entirely wanting : By this it is supposed that a piece of bone may be cut out more quickly than with the common trephine, and that the instrument need not be so frequently removed for the purpose of being cleared of the small fragments of bone produced by the saw : When the teeth of this saw are firm and properly set, it cuts both quickly and smoothly, but not better than the instrument in common use.

PLATE X.

The figures in this plate represent all the parts of the trephine separately.

Fig. 1. The handle of the trephine, which should be made of timber, and of the form here represented.

Fig. 2. The saw or head of the trephine : The upper part of it should fit
with

with much exactness an opening in the under part of the handle, so that when inserted into it the hole *B* may be opposite to the end of the screw *A*, when by turning the screw *A*, the two parts of the instrument may be firmly connected together.

C, The nut of a screw passing through a slit in the handle of the head, and fixed in the upper part of a moveable pin, *D*. In using this instrument, the point of the pin *D* is made to project past the teeth of the saw, till an impression is made upon the skull, of a sufficient depth for retaining it, when the pin should be removed: This is easily done, by moving the nut *C* to the upper part of the slit, and fixing it there by turning the screw. All the parts of the trephine are here also represented of a full size for use: The diameter of the saw should not be less than an inch. Of this size it is used with the same ease as saws of the smallest diameter,

ter, and the opening formed by it being larger, it answers the intention of the operator better.

Fig. 3. A head of a small size such as is commonly used: The pin *E* is in this instrument fixed by a screw into the bottom of the head, and is taken out by means of the key, fig. 4. but the method of moving the screw, as represented in fig. 2. is in every respect better.

Fig. 5. A perforator for forming a small hole in the centre of the piece of bone on which the head of the trephine is to be applied, and into which the pins *D*, *E*, figs. 2. and 3. must be inserted. The perforator should be exactly fitted to the handle of the instrument, fig. 1. to which it must be fixed by the screw *A* in the manner directed for fixing the head to it.

PLATE XI.

Figs. 1. and 2. represent the different parts of a levator nearly the same with that of Mr Petit. Fig. 1. a frame supported by two feet with a pin and moveable ball on the upper part of it: This pin must be of a size corresponding to the holes in the levator, fig. 3. and the ball should move with freedom in every direction, by which the point of the instrument may be carried with ease from one part to another, while the frame on which it is fixed is kept firm in its situation by an assistant.

Fig. 2. The two parts of this instrument joined together, and ready for use.

Fig. 4. The levator in common use; but this instrument, while it elevates one part of the skull, must press with so much

PLATE XI.

Fig. 1.

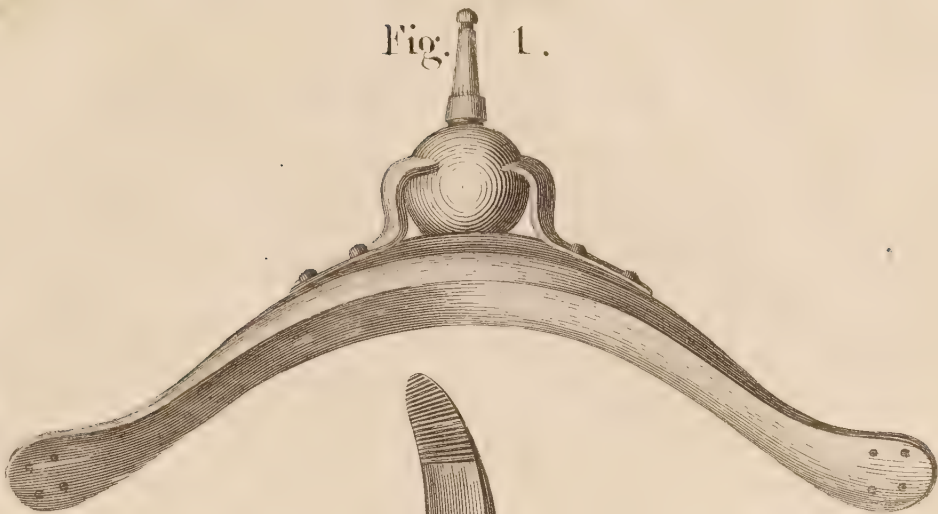


Fig. 2.

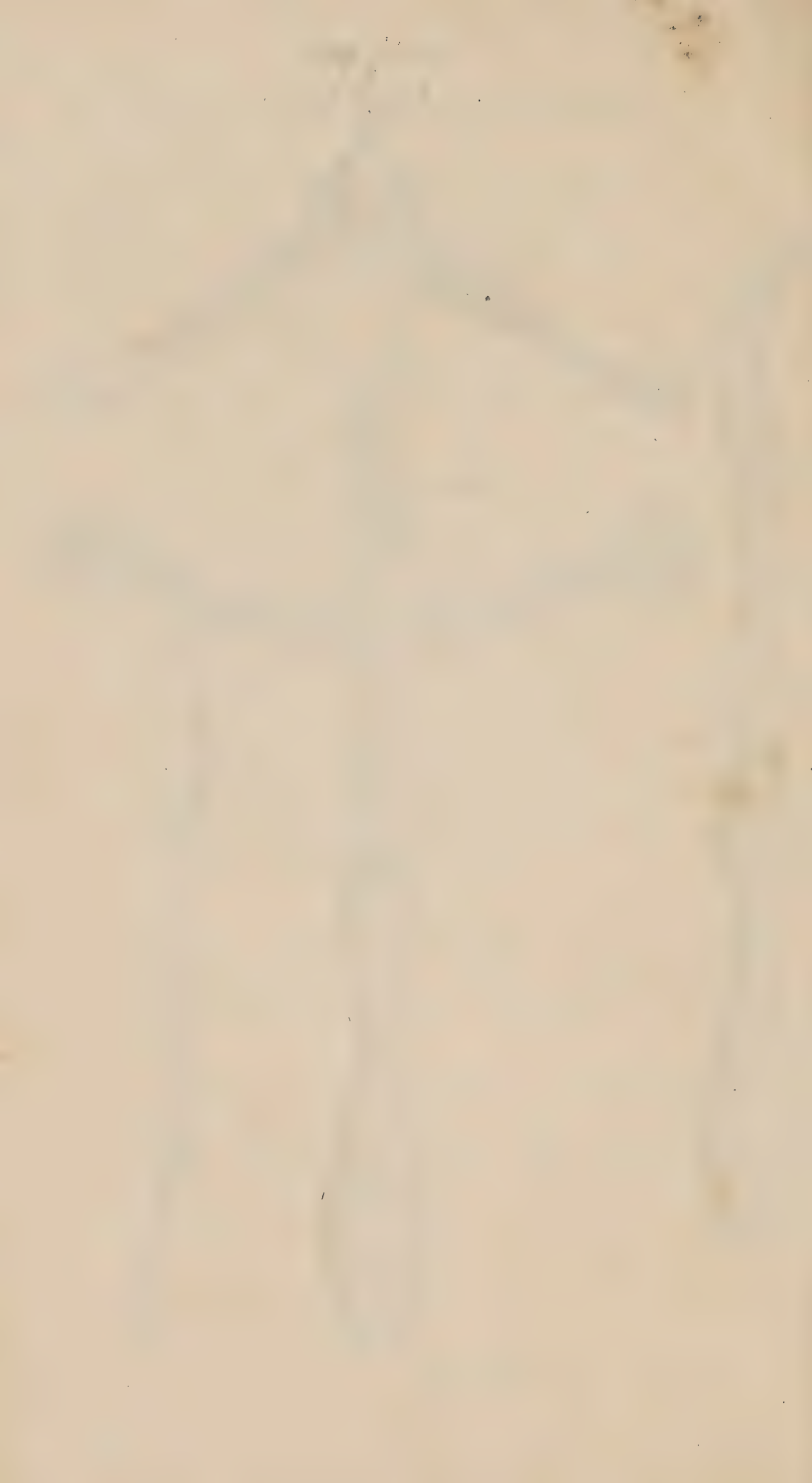


Fig. 3.



Fig. 4.





much force upon another, that it never ought to be used, especially as the levator, fig. 3. answers with perfect safety every purpose for which the other can be employed.

